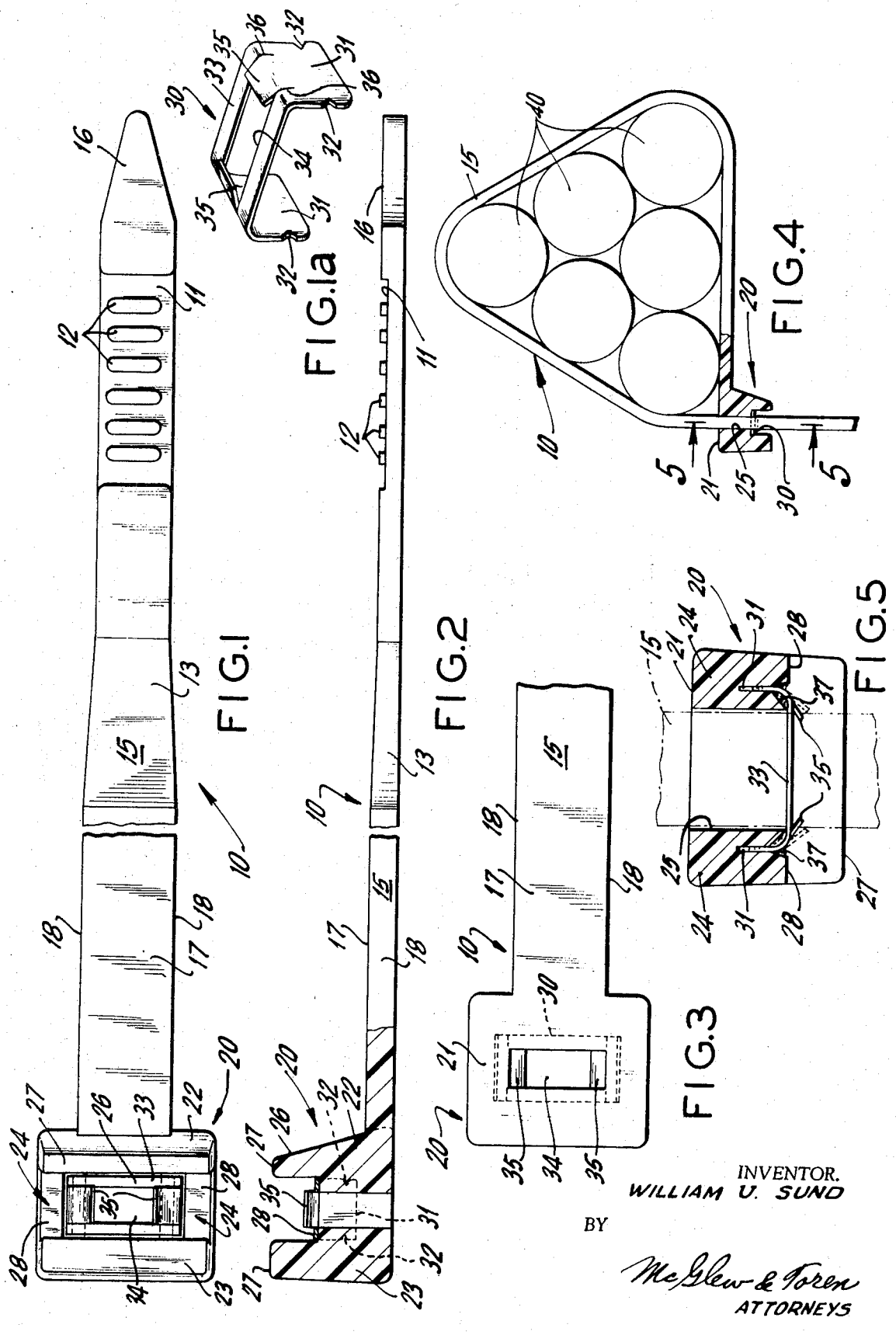
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CABLE TIE WITH METAL INSERT HAVING TWO PAWLS

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CABLE TIE WITH METAL INSERT HAVING TWO PAWLS

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ABSTRACT OF THE DISCLOSURE

A cable tie for binding plural insulated conductors or the like into a cable includes a relatively elongated substantially flat flexible tongue having an opened frame integral with one end thereof, the tie preferably being formed of a plastic composition material. The frame defines a substantially rectangular opening to receive the opposite end of the tongue which is inserted through the frame from one face thereof and drawn outwardly through the other face. A metal insert is inserted into the frame, as by the application of ultrasonic energy, and has two pawls extending inwardly toward each other and converging toward the exit face of the frame. The free ends of the pawls are spaced a substantial distance inwardly of the exit face, and the pawls flex as the tongue is drawn through the frame and then bite into the side edges of the tongue to prevent retraction of the tongue through the frame.

BACKGROUND OF THE INVENTION

In the electric wiring of aircraft, automobiles, switchboards and the like, the wiring is installed in the form of wiring harnesses comprising several insulated conductors tied together at spaced points or laced together. Thereby, the insulated conductors are united into a multi-conductor cable which can be mounted at spaced points on the supporting surface or can be supported by other suitable means. While the conductors can be cabled or formed into a cable merely by tying the conductors together with a cord, at spaced points along the conductors, or by wrapping a wire therearound and twisting the ends of the wire together, such expedients are more or less non-permanent and time-consuming and have been found to be generally unsatisfactory as tying means in practice. Accordingly, there has been a demand for a simple, inexpensive, preformed cable tie for readily and easily binding a group of insulated conductors, for example, into a cable to form for example, part of a wiring harness.

Various cable ties have been proposed in an attempt to fulfill this demand, such as those shown, for example, in Schwester et al. U.S. Pat. No. 3,186,047 and those shown in Logan U.S. Pat. Nos. 3,022,557 and 3,147,523. The cable tie disclosed in Schwester et al. includes an elongated tongue of plastic material, an open frame head at one end of the tongue adapted to receive the other end of the tongue, and a metal pawl mounted in the head and adapted to cooperate therewith and with the tongue to allow drawing of the tongue through the head while preventing retraction of the tongue in the opposite direction. The head of the cable tie is enlarged relative to the tongue portion in both lateral directions so that, particularly, in the tongue drawing direction, the head is very substantially thicker than the tongue. A passage is formed through the head and has dimensions in excess of the thickness and width of the tongue.

The "exit" side of the head is formed with aligned rectangular slots extending centrally across the aperture therethrough to both sides of the aperture. The outer slot provides clearance for insertion of the metal pawl into the inner slot and into the head material, with the pawl extending in substantially a 45° angle to the direction of passage of the tongue through the head aperture, and extending across the axis of the aperture.

When the tongue of the Schwester et al. cable tie is drawn through the aperture in the head, the metal pawl flexes to allow such drawing of the tongue tightly about a bundle of conductors. If the tongue tends to retract or withdraw through the head, a chisel edge on the pawl bites into one of the wider surfaces of the tongue and tends to resist such retraction or withdrawal. The metal pawl is very substantially narrower than the tongue and, in effect, engages or digs into the cable tie only across a pair of relatively closely spaced ribs extending longitudinally of the cable tie tongue. Additionally, the adjacent surfaces of the rectangular slot in which the metal pawl is mounted are spaced very substantially from the surfaces of the pawl so that the pawl has a wide range of flexure before it will engage either one of the facing surfaces of the mounting slot. A very pronounced disadvantage is that the chisel edge of the pawl is very close to the exit surface of the head and is nearly flush therewith.

The importance of this disadvantage will be appreciated when it is realized that, after the tongue has been drawn through the head of the tie to a cable tightening position, the projecting tongue end is severed by cutting or nipping off the projecting portion. This generally leaves a small cut end portion of the tongue projecting outwardly of the head of the cable tie, beyond the exit surface of the head, and this is unsatisfactory for many applications. In the Schwester et al. cable tie, it is not possible to cut the tongue substantially flush with the exit surface of the head, as this would result in release of the tongue from the chisel edge of the pawl. As a result, it is necessary to leave a small length of the tongue projecting from the head and extending beyond the exit surface thereof.

A further pronounced disadvantage of the Schwester et al. cable tie is that, upon reverse stress upon the tongue, the relatively great spacing between the surface of the pawl and the adjacent surface of the rectangular slot in which the pawl is mounted allows very substantial rearward flexing and bending of the pawl, to an extent that the pawl will disengage the tongue and allow loosening of the cable tie. Additionally, all of the holding stress of the Schwester et al. cable tie, when the latter is wrapped tightly around a bundle of cables or conductors, is concentrated in the relatively narrow or short chisel edge of the single metal pawl.

In the two Logan patents mentioned above, an "auxiliary means" is provided for anchoring of the tongue of the cable tie. These auxiliary means comprise apertured plates through which the projecting end of the tongue extends after the tongue has been drawn through the head of the cable tie, and the apertured plates have facing pawls which bite into the wider surfaces of the tongue. The Logan cable ties have essentially the same disadvantages as the Schwester et al. cable tie, in that, after the projecting portion of the tongue is cut off, there is still a cut edge of the tongue projecting outwardly beyond the head of the cable tie and particularly beyond the metal "auxiliary means." A further disadvantage of the Logan cable ties is that the "auxiliary means," in the form of apertured metal plates, is not integral with the cable tie per se, which is a very distinct disadvantage in practice, as will be readily appreciated.

The disadvantages of the Schwester et al. and Logan cable ties, from the sandpoint of the projecting cut edge of the tongue, which is undesirable in many applications, are overcome by the cable tie shown in Orban U.S. Pat. No. 3,368,247. The Orban cable tie is a one-piece cable

tie of flexible plastic composition material, including a tongue and a head. The head is in the form of a rectangular frame defining a substantially rectangular opening for the free end of the tongue to be drawn therethrough. At least a portion of one wider surface of the tongue is formed with a series of serrations extending thereacross, and the head is formed with an integral pawl having a transversely extending chisel edge arranged to engage these serrations when the tongue is drawn through the head. The pawl has its outer edge located a definite distance inwardly from the tongue exit surface of the head so that, when the cable tie tongue is drawn through the head, the pawl can engage these serrations to prevent retraction of the tongue and loosening of the cable tie.

Most importantly, and due to the location of the pawl a substantial distance inwardly from the exit face of the head, the projecting portion of the tongue may be cut off so that the cut edge is disposed inwardly of the exit face of the head. Thereby, there is no cut tongue edge projecting outwardly of the head of the cable tie after the cable tie has been drawn tightly around a group of insulated conductors or the like and the projecting portion of the tongue cut off.

While the Orban cable tie has proven very satisfactory in practice, particularly with respect to the location of the cut end of the tongue within the frame, and thus not projecting therefrom, due to the fact that the pawl is made of plastic and is engaged with a plastic tongue, the serrations are necessary in order to insure a firm gripping application of the plastic pawl on the plastic tongue. Furthermore, the Orban cable tie requires rather intricate molds for its manufacture, and the cost of these molds, as compared to the cost of a relatively simple mold, increases to some extent the cost of the cable tie molded therein.

The disadvantages of the Orban cable tie, from the manufacuring cost standpoint, are overcome by the cable tie shown in Pearl U.S. Pat. No. 3,397,430. Like the Orban cable tie, the Pearl cable tie includes a relatively elongated substantially flat flexible tongue preferably molded of plastic composition material, and further includes a substantially rectangular open frame or head integral with one end of the tongue. This frame defines a substantially rectangular opening to receive the opposite end of the tongue after the cable tie has been wrapped around insulated conductors or the like to tie them into a cable. The frame has a tongue entry face and a tongue exit face, and those surfaces of side walls facing toward the exit face spaced a substantial distance inwardly from the exit face.

A pair of metallic pawls are mounted in respective frame side walls, and having free ends extending inwardly toward each other and converging toward the exit face of the frame. The pawls are so positioned that three free ends are spaced a substantial distance inwardly of the exit face of the frame. As the cable tie is wrapped around insulated conductors or the like, and the tongue inserted through the frame, the pawls flex as the tongue is drawn through the frame and bite into the opposite side edges of the tongue to prevent retraction of the latter through the frame.

A limited clearance is provided between the inner surface of each metal pawl and an adjacent portion of the associated side wall, and a relatively large clearance is provided between the outer surface of each pawl and a surface of the respective side wall. These provisions facilitate flexing of the pawls as the cable tie tongue is drawn through the frame. Furthermore, due to the recessing of the exit surfaces of the frame side walls, the projecting portion of the tongue can be cut off well inwardly of the exit face of the frame, so that the cut edge of the tongue is protected by the spaced parallel end walls of the frame and is inwardly a substantial distance from the exit face of the frame.

The Pearl cable tie has proven very satisfactory in practice, but it has some disadvantages from the manufacturing standpoint. Thus, the relative positions of the metal pawls depends on the accuracy of the insertion procedure and on the consistency of the plastic composition material. This may result in "under-insertion" or "over-insertion" of the metal pawls. The importance of this will be appreciated when it is realized that the position of the metal pawls in the plastic frame or head is critical, and dictates the forces required to loop the tongue of the cable tie through the head as well as dictating the holding capability of the cable tie.

In the Pearl cable tie, the metal pawls are force-fitted into the head of the tie. However, the two separate pawls of the Pearl cable tie result in a construction which does not lend itself readily to an automation process, and the time required to complete the cable tie is increased to some extent by the necessity of accurately and consistently inserting the two metal pawls into the plastic composition frame of the cable tie.

SUMMARY OF THE INVENTION

This invention relates to cable ties for bundling insulated electrical conductors and the like into cables and, more particularly, to a novel, inexpensive and simply manufactured cable tie of flexible plastic composition material including a tongue portion and a head or frame portion, with a metal insert anchored in the frame portion and including a pair of spaced metallic pawls arranged to bite into the side edges of the tongue when the latter is inserted through the frame portion.

Stated briefly, in accordance with the present invention, a cable tie is formed of flexible plastic composition material to include a tongue portion and an open frame portion. A one-piece metal clip is inserted into the open frame portion and carries a pair of pawls engageable with side edges of the tongue portion when the latter is inserted through the frame portion after the cable tie has been wrapped around a bundle of insulated conductors or the like. Preferably, the metal clip is bonded to the frame portion by the application of ultrasonic energy in inserting the metal clip into the frame portion. The metal clip has a rectangular aperture, between the pawls, through which the tongue portion of the cable tie extends.

As distinguished from prior art cable ties, the metal clip is a uniform configuration whose shape lends itself readily to progressive die production. By producing the metal clip in a separate operation, the relationship of the metal pawls is established prior to insertion of the clip into the plastic frame of the cable tie. Thus, this relationship is consistent at all times, which means that the dimension between the pawls and the angles of the pawls relative to a reference plane will be constant. Consequently, the relative positions of the metal pawls do not depend on the accuracy of the insertion process or on the consistency of the plastic frame portion. Thus, the new cable tie is more reliable than those of the prior art.

Since the clip can be easily produced on a progressive die, the clip dimensions can be held to very close tolerances, so that the force and deflection characteristics of the metal pawls can be easily designed and checked, and repeat performance can be obtained. The metal pawls are supported by the metal clip, which has the advantage that the metal pawls on the clip do not rely on their position in the plastic frame or in the consistency of the plastic.

A feature of the invention is that the metal clip has a pair of legs each of which has a pair of notches. These notches in the legs provide for a mechanical lock of the clip within the plastic frame. Ultrasonic energy is used to insert the metal clip into the plastic frame, so that the immediate plastic layers surrounding the metal clip melt and fill the notches on each leg. This results in a mechanical bond between the metal clip and the frame of the cable tie, with the advantage that the metal clip is mechanically connected within the frame.

An object of the invention is to provide an improved

cable tie for bundling individual insulated conductors, or the like, into a cable.

Another object of the invention is to provide such an improved cable tie which is simple and inexpensive in construction and simple and inexpensive to manufacture.

A further object of the invention is to provide such an improved cable tie including a tongue portion and an open frame portion, formed of plastic composition material, and metal pawls in the frame portion arranged to engage the edges of the tongue portion when the latter is inserted through the opened frame portion, the pawls being accurately located and oriented.

Another object of the invention is to provide such an improved cable tie in which the metal pawls form part of a unitary metal insert inserted into the frame portion of the cable tie.

A further object of the invention is to provide such an improved cable tie in which the metal insert is mechanically bonded to the plastic composition material of the frame of the cable tie.

For an understanding of the principle of the invention, reference is made of the following description of a typical embodiment thereof as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a plan view of a cable tie embodying the invention;

FIG. 1*a* is a perspective view of a metal insert included in the cable tie shown in FIG. 1;

FIG. 2 is a side elevation view, partly in section, of the cable tie shown in FIG. 1;

FIG. 3 is a partial plan view of the cable tie, illustrating the surface thereof opposite that shown in FIG. 1;

FIG. 4 is an end elevation view, partly in section, illustrating the cable tie as applied to bundle a number of insulated conductors; and

FIG. 5 is a sectional view taken on the line **5**—**5** of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in FIGS. 1, 2 and 3 of the drawings, the invention cable tie **10** is a substantially flat and elongated flexible strip preferably molded from a suitable plastic composition material or synthetic resin. For example, cable **10** may be molded from a nylon resin.

The cable tie includes a relatively elongated tongue **15** and a rectangular frame or head which is integral with one end of tongue **15**, or forms a single piece therewith, as by molding the entire cable tie **10** in a single operation. The opposite end of tongue **15** is tapered, as at **16**, for a purpose to be described. Tongue **15** is in the nature of a flat strap having substantially flat relatively wide surfaces **17, 17** and side edges **18, 18**. Just inwardly of tapered end **16**, one or the other of the surfaces **17** may be formed with a recess or thinned portion **11** further formed with a plurality of transversely extending ribs or the like **12** facilitating gripping of the tongue and drawing of the tongue around a bundle of conductors or the like. As best seen in FIG. 1, the portion of tongue **15** adjacent frame **20** is relatively wider than the portion of tongue **15** formed with the recess **11**, both portions having parallel side edges. The two portions of the tongue merge smoothly with each other through the medium of an intermediate tapered transition portion **13**. While tongue **15** is shown as of the same thickness throughout its length, except for the recessed or thinned portion **11**, it is not absolutely necessary that the tongue be of uniform thickness throughout its length, and variations in thickness can be introduced, particularly toward the tapered outer end **16**.

Head **20** is in the form of a substantially rectangular open frame which is wider than tongue **15** and very substantially thicker. Head or frame **20** has a tongue entry surface **21** which is substantially flush with the bottom surface **17** of tongue **15**, as viewed in FIG. 2, and as will be readily apparent from FIG. 3. The frame or head **20** further includes substantially parallel inner and outer end walls **22** and **23**, respectively, which are interconnected by substantially parallel side walls **24**, the four walls defining an opening **25** through head **20**. Inner end wall **22** is substantially trapezoidal in cross section, with its outer sloping surface **26** merging substantially smoothly with a surface **18** of tongue **15**. The substantially coplanar surfaces of end walls **22** and **23**, opposite those surfaces of these end walls included in the tongue entry surface **21**, define tongue exit surfaces **27**. It will be noted, particularly from FIGS. 2 and 5, that those surfaces **28** of side walls **24** facing toward the tongue exit side of frame **20** are disposed substantially inwardly of the surfaces **27** of the end walls **22** and **23**. Thus, the width or height of side walls **24** is only of the order of slightly more than half the width or height of end walls **22** and **23**, as will be clearly apparent from FIG. 5.

In accordance with the invention, the metal pawls for biting into the edges of the tongue inserted through the frame **20** are provided as integral parts of a one-piece metal clip **30**, best seen in FIG. 1*a*. Metal clip **30** is substantially U-shaped and may be formed by die cutting and die stamping from a continuous strip of metal. Also, the clip is inserted as a unit into the frame **20**, thus obviating the necessity for independently positioning two separate pawls in the frame, as required, for example, in Pearl U.S. Pat. No. 3,397,430. This greatly expedites and simplifies the manufacturing operations required for producing the cable tie **10**.

Referring to FIG. 1*a*, metal clip **30** includes a pair of legs **31** each formed with notches **32** in opposite side edges thereof. Legs **31** are interconnected by a base **32** formed with a rectangular opening **34** therethrough. Opening **34** has width and height dimensions of the order of just slightly greater than the width and thickness of tongue **15** of cable tie **10**. Pawls **35** are struck out from clip **30** as partial extensions of the legs **31**, and are inclined inwardly toward each other. Due to the flexibility of the metal of clip **30**, pawls **35** are also flexible, at least to a limited extent, and it will be noted that the die cuts **36** defining each pawl **35** extend somewhat into the associated legs **31**.

Metal clip **30** is inserted into frame **20** in such a manner that the pawls **35** project somewhat outwardly from the exit surfaces **28** of frame **20** and extend inwardly toward each other across the opening **25** in a position to engage the side edges **18** of tongue **15**. The insertion of clip **30** into frame **20** is effected by the application of ultrasonic energy, with legs **31** being inserted into the side walls **24** of the frame. The use of ultrasonic energy results in the immediate plastic layer surrounding metal clip **30** melting and filling the two notches **32** of each leg. In turn, this results in a mechanical bond between metal clip **30** and the frame **20** of the cable tie, so that the metal clip is mechanically connected within the frame **20**. The insertion process is continued until the base **34** of clip **30** abuts against the exit surfaces **28**. In FIG. 5, the melted plastic layers are indicated at **37**.

Referring to FIGS. 4 and 5, in using cable tie **10**, the cable tie is drawn around a group of conductors **40**, preferably insulated conductors, and tongue **15** is inserted through frame **20** from entry surface **21** toward exit surfaces **27** and **28**. The tongue thus has a reasonably close fit through opening **25** in frame **20** and a reasonably close fit through opening **34** of base **33** of metal clip **30**. As the tongue **15** is drawn through frame **20**, to wrap cable tie **10** firmly around conductors **40**, the pawls **35** flex. When the "tying" pressure or tension on the cable tie is released, the pawls **35** bite or dig into the side edges **18** of tongue **15** to prevent retraction thereof from the exit faces of frame **20** toward the entrance surface **21** thereof.

Among the advantages of the present invention, as compared to prior art cable ties, are that the metal clip **30** is a uniform configuration having a shape lending itself readily to progressive die production. By producing clip **30** in a separate operation, the relationship of metal pawls **35** is established prior to insertion to clip **30** into the plastic composition material frame **20**, and thus the relationship between the pawls is consistent. This means that the distance between the pawls, and the angles of the pawl in relationship to a reference plane, are always constant. The relative position of the metal pawls does not depend, in any way, either on the accuracy of the insertion process or on the consistency of the plastic composition frame. Even if clip **30** is under-inserted or over-inserted into frame **20**, the relationships remain consistent, so that the cable tie is more reliable than known cable ties.

Since clip **30** can be easily produced on a progressive die, the clip dimensions can be held to very close tolerances, and thus the force and deflection characteristics of metal pawls **35** can be easily designed and checked, and repeat performances can be obtained. The metal pawls are supported by metal clip **30**, which is an improvement over the use of separate pawls force fitted into the frame **20** separately. Additionally, the uniformity of clip **30** lends itself to ultrasonic insertion into the plastic composition frame **20**, and therefore eliminates the need for brute force to insert a separate metal pawl into the frame. Because clip **30** is made in a single piece, the insertion time is less than that required for inserting two separate pawls. Additionally, the entire process of inserting metal clip **30** can be automated so that the plastic cable ties are fed into a machine at one end and the complete product emerges from the other end of a machine. This results in a uniform cable tie, since it does not rely on proper feeding of the tie by an operator, in addition to which the automation of the insertion process eliminates some of the variables that are introduced by manual operations.

Since ultrasonic technology is used to insert metal clip **30** into frame **20**, only relatively low forces are required to effect such insertion. Thus, the component parts of a production machine will have a longer life than if the production machinery were subjected to dynamic loadings.

What is claimed is:

1. In a cable tie, for binding plural insulated conductors or the like into a cable, of the type comprising a relatively elongated substantially flat flexible tongue, a substantially rectangular open frame integral with one end of the tongue and including substantially parallel inner and outer end walls interconnected by substantially parallel side walls to define a substantially rectangular opening to receive the opposite end of the tongue, the frame having a tongue entry surface and a tongue exit surface: the improvement comprising a one-piece metal clip inserted in said frame inwardly of said exit surface of said frame; said clip having a substantially rectangular opening therethrough whose lateral dimensions approximate those of the opening in said frame, the two openings being in aligned continuation of each other; said clip having a pair of metal pawls integral therewith, at respective opposite shorter edges of said clip opening, having free ends extending inwardly toward each other and converging toward said exit surface; the free ends of said pawls being spaced a substantial distance inwardly of said exit surface; said pawls flexing as said tongue is drawn through said frame from said entry surface, and biting into the side edges of said tongue to prevent retraction of the latter through said frame.

2. In a cable tie, the improvement claimed in claim **1**, in which said end walls have surfaces coplanar with said tongue exit surface; said side walls having surfaces, facing toward said tongue exit surface, which are spaced a substantial distance inwardly from said tongue exit surface; said clip being seated on said last named surfaces of said side walls.

3. In a cable tie, the improvement claimed in claim **1**, in which said cable tie is formed of plastic composition material; said clip having portions imbedded in the plastic composition material of said frame.

4. In a cable tie, the improvement claimed in claim **1**, in which said cable tie is formed of plastic composition material; said clip being substantially U-shaped including a base and a pair of legs, each extending from a respective opposite end of said base; said base having said clip opening formed therethrough; said legs being imbedded in the plastic composition material of said frame.

5. In a cable tie, the improvement claimed in claim **4**, in which said end walls have surfaces coplanar with said tongue exit surface; said side walls having surfaces, facing toward said tongue exit surface, which are spaced a substantial distance inwardly from said tongue exit surface; said legs being imbedded in said side walls with said clip base engaging said last-named surfaces of said side walls.

6. In a cable tie, the improvement claimed in claim **5**, in which said pawls extend from the junctions of said base and said legs and project outwardly from said base.

7. In a cable tie, the improvement claimed in claim **6**, in which said pawls are substantially rectangular, the side edges of said pawls being aligned with the longer edges of said clip opening; the side edges of said pawls being continued as slits extending a short distance into each respective leg of said clip.

8. In a cable tie, the improvement claimed in claim **6**, in which said clip legs are substantially rectangular; each leg having at least one notch in a side edge thereof; said notches interlocking with the plastic composition material of said frame.

9. In cable tie, the improvement claimed in claim **8**, in which said base is substantially rectangular, said base and said legs being equal in width and said legs extending substantially perpendicularly from said base.

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