A manually operated semi-automatic tool for tying wire bundles with a plastic cable tie and cutting the tie a predetermined tension by the actuation of a trigger. The tool is of gunlike shape having a nose section of minimum dimension especially adopted for miniature harnessing. The mechanical components are especially designed to be contained in a housing shaped for more effective miniature harnessing operations common to modern electronic packaging.
SEMI-AUTOMATIC TYING AND CUTTING TOOL FOR HARRING AND WIRE BUNDLING

This tool is used to install cable ties on harnesses and wire bundles.

Harnessing and point-to-point wire bundling have been an integral part of modern electrical and electronic packaging. Several harnessing methods are known but the most advanced technique is the cable-tie method.

The cable tie is an injection molded product which consists of a head and long tail. The head has a hole in which the tail will be inserted. The tie is self-locking therefore the inserted tail cannot slip backward. This quality enables these devices for tying and fastening purposes. The tie has to be slipped around the wire bundle, inserted into the self locking head and tightened. Finally the excess has to be cut off.

The actual harnessing work is quite simple and rapid. The worker wraps tie around wire bundle, inserts the tail into the head and pulls it up tightly by his hand. From this stage the operation is performed by semi-automatic power or manual tools.

It is therefore the primary object of this invention to provide a tying and harnessing tool especially designed for effective operation in miniature packaging of electronic wiring components whereby said tool is of gunlike shape with a relatively small nose cross-section and provided with means for securing cable ties about wire bundles and cutting cable tie at a desired predetermined tension.

It is a further object to provide a wire harnessing and cutting tool that will have a minimum of mechanical components and a shape particularly suitable in miniature harnessing.

It is still a further object of this invention that the above described tool be inexpensive to fabricate, assemble and adjust.

Further objects of this invention will become apparent from the following description and accompanying drawings wherein:

FIG. 1 is an assembly drawing of the tool partly in section showing the position of mechanical components before actuation.

FIG. 2 is a transverse section taken along plane 2-2 of FIG. 1.

FIG. 3 is an assembly drawing of the tool showing an intermediate position of mechanical components during actuation.

FIG. 4 is an assembly drawing of the tool in the final position during actuation.

Referring now to the drawings, the tool assembly comprises a gun shaped housing 1 having a handle 2, a hollow rear barrel 2a integral with a reduced front barrel section 2b terminating at a nose area which receives the cable tie. A trigger 3 is connected to the front barrel by a fixed pivot 3A. A link 7 is connected by a fixed pivot 7a to the trigger and extends into the rear barrel cavity where said link 7 is connected by pivot 7b to an elbow link 8 to be described in further detail hereinafter. A cylinder 9 is slidingly mounted in the rear barrel cavity and is adapted to move axially from the forward position (prior to actuation) shown in FIG. 1, to a rearward position (after actuation) shown in FIG. 4. The cylinder 9, has a recess 9a, in which is slidably mounted a hollow piston 6 that extends outwardly of the cylinder to abut the elbow link 8. A roller 19 is affixed to the rear leg of elbow link 8 whereby axial thrust is transmitted from the elbow link to the piston 6. A compression spring 16 is mounted axially in the piston and bears against the piston wall biasing said piston forward. The rear end of spring 16 extends rearwardly out of the piston and bears against an adjustable screw 15 mounted in the cylinder 9, whereby the spring compression can be varied by adjusting screw 15.

Elbow link 8 is connected to the cylinder 9 by a fixed pivot 9b and will rotate about pivot 9b only when the piston 6 moves rearward relative to roller 19 as will be more fully explained. Thus in the position shown in FIG. 1, actuation of trigger 1 will cause link 7 to thrust against the elbow link 8. Because elbow link 8 is restrained from rotation about pivot 9b due to back pressure from spring 16 acting on the piston 6, the elbow link and the attached cylinder 9 will move at first only in a rearward axial direction. Subsequently the rearward motion of the cylinder will be arrested by means to be described. When the rearward motion is so arrested, then, further actuation of the trigger will cause the roller 19 to rotate about the pivot 9b thereby resulting in further compression of spring 16 and rearward motion of piston 6 relative to cylinder 9 for purposes to be described hereinafter.

A forked member 4 is mounted in a front barrel lower recess 2c and has bifurcations 4a and 4b (See FIG. 2) which extend rearwardly into the rear barrel 2a and along spaced slots 4c and 4d formed longitudinally in the sides of the cylinder 9. A pair of tension springs 14a and 14b are attached to the rear end of bifurcations 4a and 4b at one end 21 and to the cylinder at the other end 22. The forked member 4 is pivotally affixed to the front barrel at pivot 3c whereby it is restrained from axial motion. Thus the cylinder 9 is biased axially forwardly because of the connection to the forked member 4. The forward end of forked member 4 is pivotally connected at 23 to a cutter lever 5 which is pivotally affixed to the front barrel by pivot 24. Cutter lever 5 has a knife 25 attached thereto which moves transversely into a slot formed in a cable tie receiver 18 mounted in the nose 26 of the front barrel 2b. Thus it is seen that counterclockwise motion of forked member 4 about pivot 3c causes clockwise motion of cutter lever 5 about pivot 24 whereby knife 25 moves upward into the slot in the cable tie receiver 18 to cut the cable tie which passes through aligned bores 27 formed axially in the receiver 18.

For the purpose of grasping and applying tension to the cable tie 28 (See FIG. 3) a pull rod assembly is provided comprising a support 29 rod 10 and a forwardly extending gripper mechanism 11. The support rod 10 is secured to the cylinder 9 in a recess 29 and extends slidable in the front barrel forwardly to a removable connection with the gripper mechanism 11 which extends to close adjacency with the receiver 18. A gripper 13 having teeth at its lower side is slidably mounted in an inclined recess 30 formed in the assembly 11. A spring 17 biases the gripper 13 outwardly from the recess and towards the cable tie for gripping purposes. Prior to actuation of the trigger 3 (FIG. 1) the gripper 13 abuts the receiver 18 causing said to be forced into the recess 30 and away from contact with the cable tie against the action of spring 17. As soon as the gripper is moved rearward (as will be described) the gripper 13 is released from the pressure of receiver 18 whereby the gripper is forced out of the recess 30 into gripping contact with the cable tie.
As better seen in FIG. 3, a wire bundle 31, to be harnessed, is encompassed with the usual cable tie 28. The tail of the cable tie is received in the front barrel through nose 26 and passes through bores 27 and is guided axially by a slot 32 (See FIG. 3) rewardly and thus in an inclined slot 33 downwardly to a position beneath the front barrel.

OPERATION

With the cable tie in position as shown in FIG. 3, the trigger is squeezed causing a sequentiant motion of the internal components from the initial position of FIG. 1 then to the position of FIG. 3 and to the final position of FIG. 4 where cutting takes place.

Initial actuation of trigger 3, as seen in FIG. 1, causes link 7 to thrust against the elbow link 8. Because elbow link 8 is restrained from rotation due to contact with piston 6, the piston is moved rearward along with the cylinder 9 causing stretching of springs 14a and 14b. Movement of cylinder 9 causes rearward motion of rod 19 and gripper mechanism 11 whereby gripper 13 is urged outward of recess 30 by spring 12 to engage and grip the tail of cable tie 28 pulling said tie rearward to apply tension to the cable tie. The reaction of the wire bundle 31 against the nose of the barrel results in the application of increasing tension in the tie and a forward pull on the gripper mechanism which is transmitted via rod 10 to cylinder 9. This action continues until the position of FIG. 3 is reached wherein it is noted that the cylinder 9 has moved rearwardly a distance indicated by D. When the cylinder 9 has moved the distance D, the desired tension in the cable tie has been attained and the rearward thrust caused by trigger 3 is balanced by the tension in the cable tie urging the cylinder forward plus the forward pull on the cylinder by springs 14a and 14b. With the longitudinal forces on the cylinder in balance, as seen in FIG. 3, further squeezing of trigger 3 results in compression of spring 16 and rearward movement of the piston 6 relative to the cylinder 9. When piston 6 moves rearward relative to the cylinder, the roller 19 is released for counterclockwise rotation about pivot 9b whereby the lever 5 is rotated clockwise about pivot 23 causing the knife 5 to move upward in the slot of receiver 18 to cut the cable tie at the desired tension, as shown in FIG. 4.

As soon as the cable tie is cut the trigger is released and springs 14a and 14b return the cylinder and the actuating mechanism to the initial position of FIG. 1.

It is thus apparent that the tool described hereinabove will sequentially cause a predetermined tensioning of a cable tie, cut the tie at such tension and return the mechanism to the initial position for further similar operation. The desired tension at which cutting takes place is set by the screw 15 which adjusts the amount of compression in spring 16 which will result in release of roller 19 for actuating the cutting knife.

Because of the novel construction of gripping mechanism 11, the cutting lever and nose construction, a front barrel 29 design is provided of minimum cross-section particularly suited for efficient miniature harnessing. Furthermore the overall design provides a lightweight uncomplicated tool that can be fabricated, assembled and maintained with minimum costs and time expenditure.

The novel features and operation of this device, apparent from the foregoing description, is not limited to the exact form disclosed and may be modified within the scope and spirit of this invention.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. A device for applying predetermined tension to a cable tie and automatically cutting the cable tie at said tension comprising: a longitudinal barrel having a front barrel portion and a rear barrel portion; a handle extending transversely from said barrel; a trigger pivotally attached to said barrel and extending transversely therefrom in spaced relation to said handle; first means mounted slidably in said barrel and adapted to grip a cable tie received in said barrel; cylinder means reciprocatingly slidably disposed in said rear barrel portion and connected to said first means so that movement of said cylinder means causes corresponding movement of said first means; second means slidably disposed in said cylinder means and resiliently coupled thereto so that movement of said second means selectively causes movement of said cylinder means; third means coupling said trigger to said second means, wherein actuation of said trigger towards said handle causes longitudinal rearward movement of said second means and said cylinder means and gripping of said cable tie to apply tension thereto as said cylinder means moves rearward; and an articulated assembly in said front barrel portion having cutter means thereon and coacting with said third means, said third means being movable responsive to the pressure exerted thereon by said cylinder means whereby rearward motion of said first means is arrested when the said tension is caused in the cable tie whereupon said third means activates said articulated assembly and said cutter means effecting cutting of said cable tie.

2. A device as defined in claim 1 wherein said articulated assembly includes a pivoted first portion to which said cutter means is attached, said cutter means being adapted to move transversely against the cable tie.

3. A device as defined in claim 1 wherein said third means includes a pivoted link movable between said second means and said articulated assembly, said second means abutting said pivoted link and being spring biased to a position retaining the pivoted link against rotation until said tension is attained whereby the further movement of said second means is arrested permitting rotation of said pivoted link in response to further trigger actuation.

4. A device as defined in claim 3 wherein said second means is a hollow piston within which is longitudinally disposed spring means resiliently coupling said piston to said cylinder means.

5. A device as defined in claim 4 further comprising means cooperative with said spring means for varying the resilient coupling between said piston and said cylinder means.

6. A device as defined in claim 1 further comprising spring means connecting said articulated assembly to said cylinder means to selectively bias said articulated assembly to a first position out of engagement with a cable tie received in said barrel.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,752,199 Dated August 14, 1973

Inventor(s) Imre Fekete

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 21 "19" should be corrected to "10"

Signed and sealed this 1st day of January 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents