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Schaefer et al.

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[54] **APPARATUS FOR CUTTING AND SEPARATING RIBBON WIRE**

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[73] Assignee: **Ram Products Company,** Inglewood, Calif.

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[52] **U.S. Cl.** **83/302,** 83/481, 83/500, 83/673, 83/678

[51] **Int. Cl.** **B26d 1/28,** B26d 9/00

[58] **Field of Search** 83/302, 500, 673, 83/675, 663, 678, 676, 37, 481

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Primary Examiner—Frank T. Yost
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[57] **ABSTRACT**

An apparatus for cutting and separating ribbon wire comprising first and second separating members with each of the separating members having at least one rib and at least one recess. At least one of the separating members has a cutting element. The separating members are mounted with the recess and rib of the first separating member generally confronting the rib and recess, respectively, of the second separating member. The first separating member is movable relative to the second separating member to cause the ribs of the separating members to force the first and second wires of the ribbon wire into the first and second recesses, respectively, to separate the first and second wires and to force the cutting element against at least one of the wires to sever such wire.

8 Claims, 12 Drawing Figures

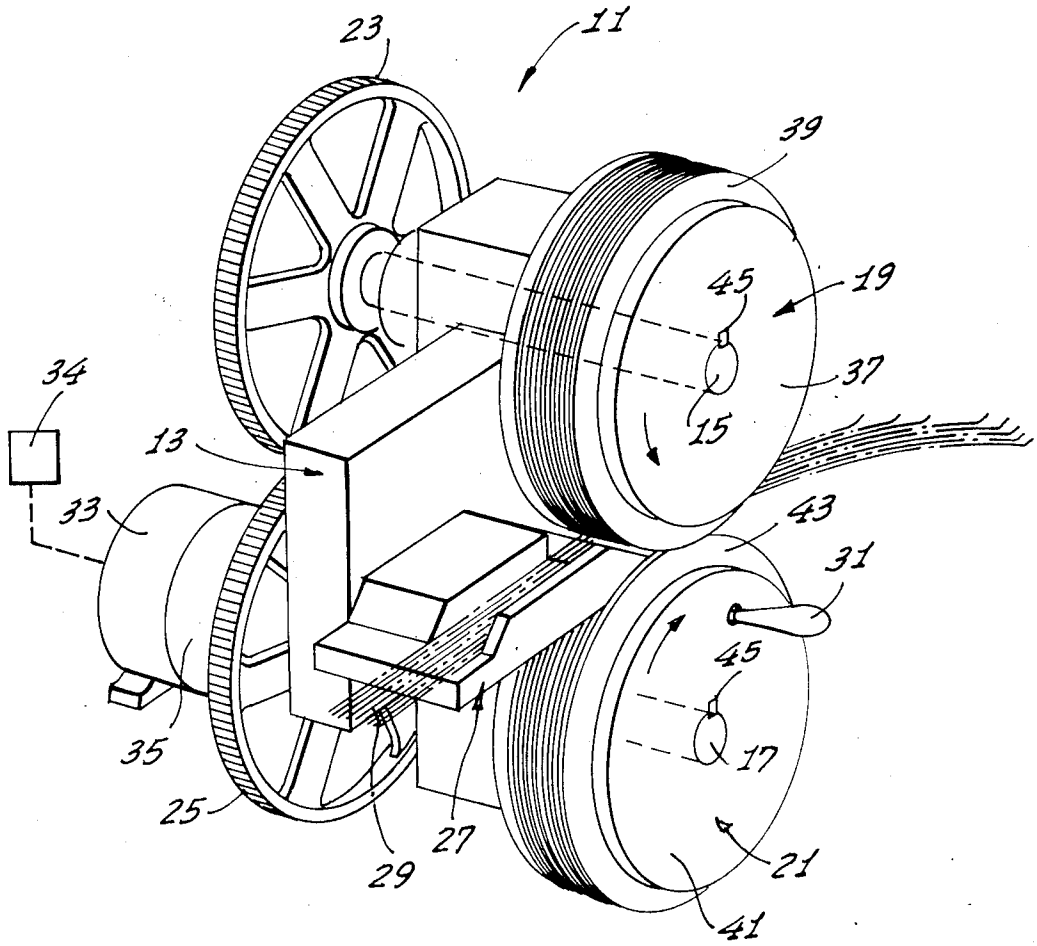


Fig. 1

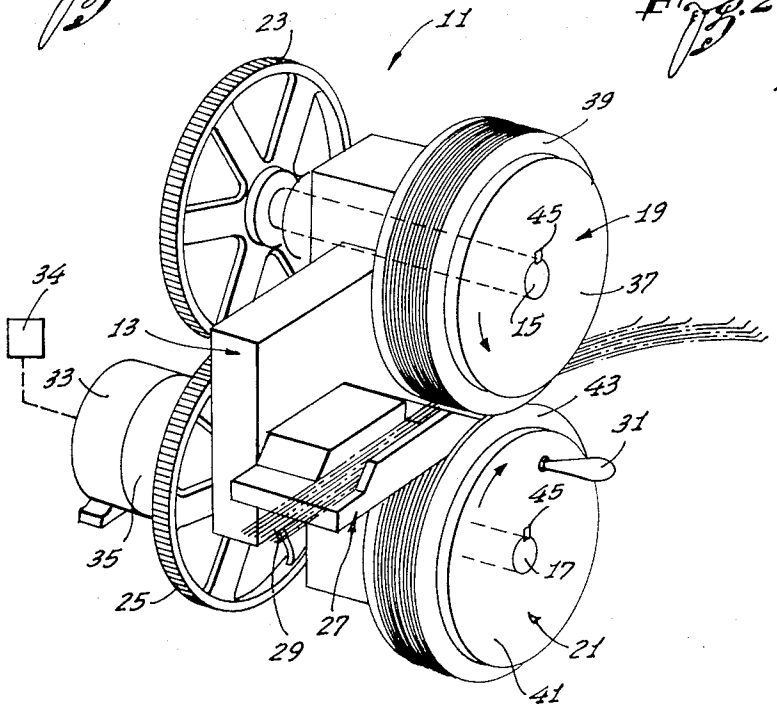


Fig. 2

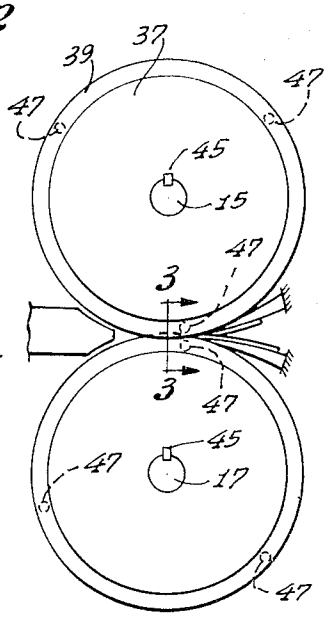


Fig. 3 (Separating)

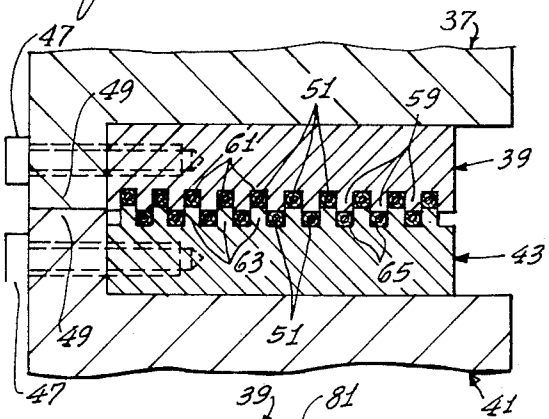


Fig. 4 (Cutoff)

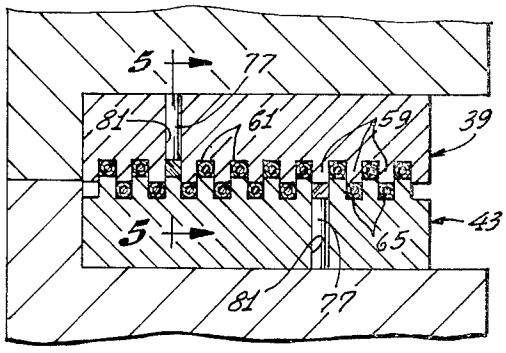
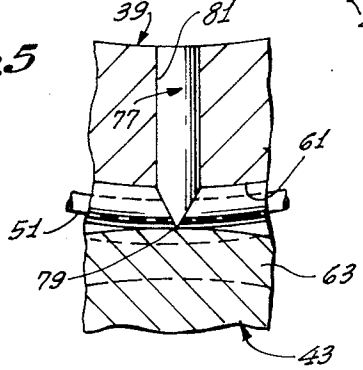


Fig. 5



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Fig. 6

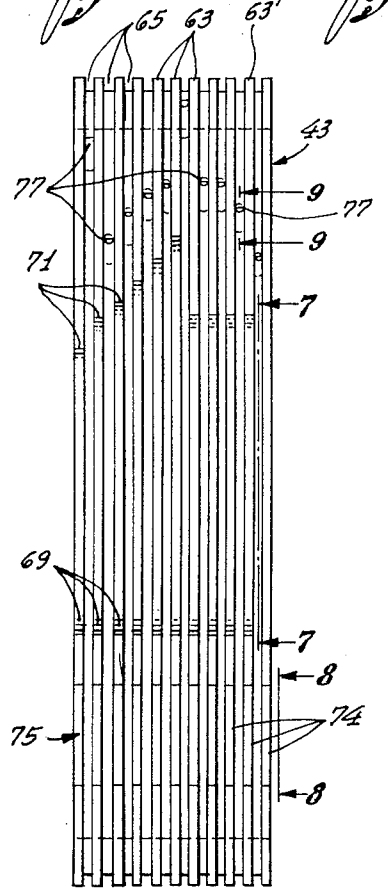


Fig. 7

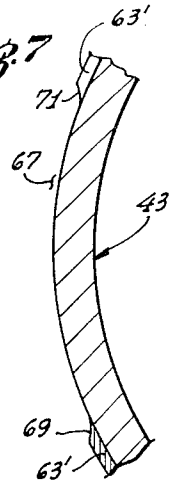


Fig. 8

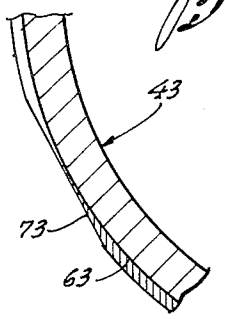


Fig. 9

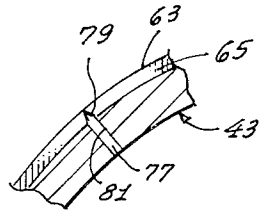


Fig. 10

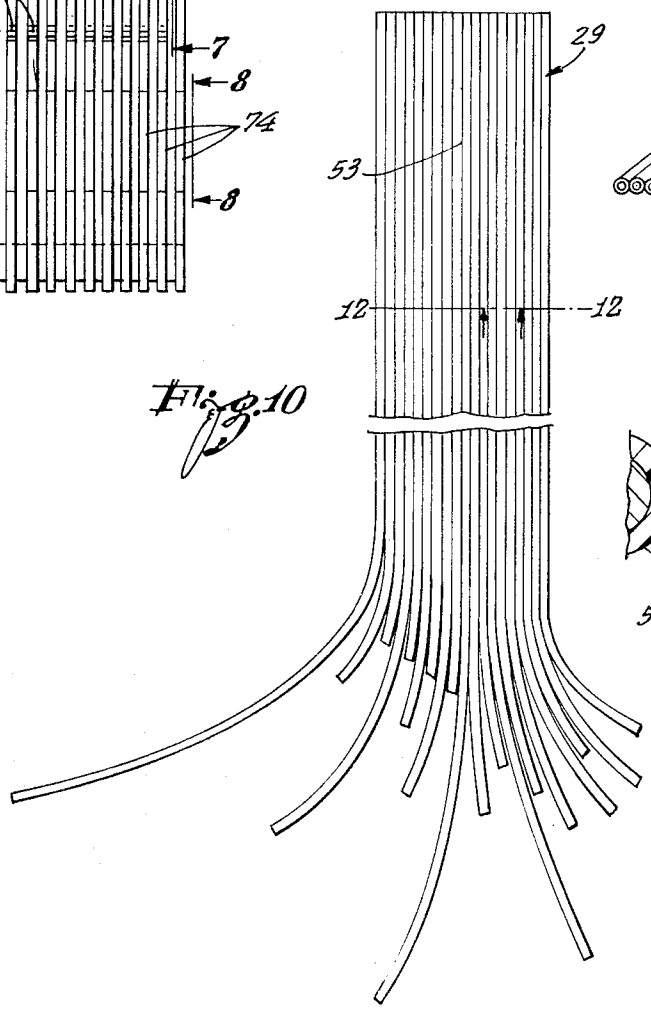


Fig. 11

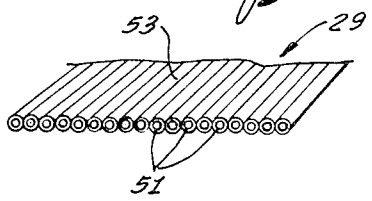
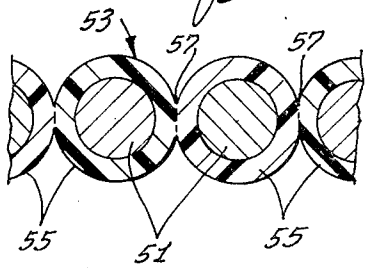


Fig. 12



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APPARATUS FOR CUTTING AND SEPARATING RIBBON WIRE

BACKGROUND OF THE INVENTION

Ribbon wire is often used to make various electrical connections including certain electrical connections for computers. Ribbon wire includes a plurality of conductive wires held together in generally parallel relationship by a body of insulating material.

Prior to use, the ribbon wire must be separated, i.e., the insulating body must be severed or fractured to allow each of the wires with its associated insulation to be pulled free from the remainder of the group. This separating action must occur along a preselected length of each of the wires with such preselected lengths varying from wire to wire and from one application to another. Thus, there is no standard length along which each of the wires of the ribbon wire must be separated.

Prior to use, many of the wires of the ribbon wire must also be cut to an appropriate length. Here again, there is no standard length for each of the wires. The result is that many of the wires must be cut to different lengths.

It is common practice to have these cutting and separating functions performed by hand. This takes considerable time and significantly increases labor cost. It is also difficult to accurately perform the separating and cutting operations by hand.

SUMMARY OF THE INVENTION

The present invention provides an apparatus and method for separating and cutting ribbon wire which generally overcomes the disadvantages noted above. The present invention provides an apparatus which can be preprogrammed to separate and cut ribbon wire in accordance with a predetermined program. Wire which is fed into the machine is rapidly and automatically separated and cut.

According to the present invention, the separating function is carried out by first and second separating members having cooperating ribs and grooves thereon. The ribs on each of the separating members are aligned with the grooves on the other of the separating members. The ribbon wire is placed between the separating members with the wires aligned with the grooves, and the separating members are relatively moved so that the ribs can relatively offset the wires into the associated grooves. This has a shearing effect on the insulating body with the result that the insulating body is severed to thereby separate the wires.

The length of each of the wires which is separated from the other wires is controlled by the length of the associated rib. According to the present invention, the rib is reduced in size or eliminated along those regions of the associated wire which is not to be separated. By appropriately adjusting the lengths of the ribs, a program for separating the wires is established. Of course, any number of the ribs and grooves can be utilized depending upon the number of wires which make up the ribbon wire.

The cutting function is carried out by one or more cutting elements mounted on one or both of the separating members in line with an associated wire. One cutting element is provided for each wire that is to be cut. The cutting element is located at the point at which the associated wire is to be severed.

Although the separating members could take the form of dies and be operated in a press, advantageous results are obtained by constructing each of the separating members in the form of a rotor rotatably mounted on a supporting structure. Each of the rotors has a peripheral surface which contains the ribs and grooves and the peripheral surfaces are closely adjacent. A driving connection between the rollers is provided to assure that the rotors will rotate synchronously. To facilitate starting of the operation, the ribs of at least one of the rotors have a reduced radial dimension at a starting location. This provides a slight radial gap into which the end of the ribbon wire can be inserted.

Normally, all of the wires will be separated during the initial phase of rotation of the rotors. Next, the cutting element will cut a selected wire and at some preselected time thereafter the rib for separating the selected wire is reduced in size radially or totally eliminated so that no further separation of the selected wire occurs.

Each of the separating members preferably includes a core and a sleeve with the sleeve being removably mounted on the core for rotation therewith. The ribs and grooves are formed in the peripheral surface of the sleeve. A new separating and cutting pattern can be quickly and easily implemented by merely exchanging one sleeve for another.

The cutting elements can advantageously be mounted on the sleeve. Preferably the cutting element projects radially into a groove of the sleeve to which it is attached. Although the cutting element can be mounted so that it projects through a rib, if so mounted there is some danger that the cutting element may partially cut or nick an adjacent wire and/or the insulation therefor. If each wire is to be cut and the cutting elements are to be mounted only in grooves, then both of the sleeves must have cutting elements mounted thereon with, for example, all even number wires being cut by cutting elements on one sleeve and all odd number wires being cut by cutting elements on the other sleeve.

The invention can best be understood by reference to the following description taken in connection with the accompanying illustrative drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a separating and cutting apparatus constructed in accordance with the teachings of this invention.

FIG. 2 is a side elevational view of the two separating members.

FIG. 3 is an enlarged fragmentary sectional view taken generally along line 3—3 of FIG. 2.

FIG. 4 is an enlarged fragmentary sectional view taken on a generally radial plane through the separating members at such a position as to show two of the cutting members.

FIG. 5 is an enlarged fragmentary sectional view taken along line 5—5 of FIG. 4 and illustrating one of the cutting members and the surrounding structure.

FIG. 6 is a plan view of the sleeve portion of one of the separating members.

FIG. 7 is a fragmentary sectional view taken generally along line 7—7 of FIG. 6 and illustrating a typical manner in which one of the ribs may be cut away to terminate the separating operation.

FIG. 8 is an enlarged fragmentary sectional view taken generally along line 8—8 of FIG. 6 illustrating the starter section of the separating member.

FIG. 9 is an enlarged fragmentary sectional view taken generally along line 9—9 of FIG. 6 and illustrating one of the cutting members.

FIG. 10 is a plan view of a typical length of ribbon wire with one end of the ribbon wire having been separated and cut by the apparatus shown in FIG. 1.

FIG. 11 is a fragmentary perspective view of the unseparated end of the ribbon wire.

FIG. 12 is an enlarged fragmentary sectional view taken generally along line 12—12 of FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows an apparatus 11 constructed in accordance with the teachings of this invention. The apparatus 11 generally includes a supporting structure 13, a pair of parallel shafts 15 and 17 mounted for rotation on the supporting structure 13, separating members in the form of rotors 19 and 21 mounted on the shafts 15 and 17, respectively, for rotation therewith, and gears 23 and 25 mounted on the shafts 15 and 17, respectively, for rotation therewith. The apparatus 11 also includes a feed tray 27 mounted on the supporting structure to facilitate the feeding of ribbon wire 29 between the rotors 19 and 21. The apparatus 11 includes an operating handle 31 mounted on the rotor 21, and it may also include an electric motor 33 drivingly connected to the shaft 17 through a clutch 35.

More specifically, the supporting structure 13 may consist of any structure suitable to mount the other components of the apparatus 11. In the embodiment illustrated, the shafts 15 and 17 are mounted for rotation on the supporting structure 13 by bearings (not shown) for rotation about vertically spaced, parallel, horizontal rotational axes.

The gears 23 and 25 mesh to assure that the rotors 19 and 21 rotate together in accordance with a predetermined program. In the embodiment illustrated, the ratio of the gears 23–25 is 1—1 so that the angular velocity of the rotors 19 and 21 is equal.

The rotors may be driven either manually by the handle 31 which projects axially of the rotor 21 or by the motor 33. When the apparatus 11 is being driven manually, the clutch 35 should be disengaged. As one revolution of the rotors 19 and 21 is all that is normally required for a section of ribbon wire 29, a controller 34 is provided which causes the motor to automatically rotate through only one revolution or whatever number of revolutions of the motor are necessary to impart one revolution of each of the rotors 19 and 21. Of course, a suitable gear reduction mechanism may be employed between the motor 33 and the clutch 35, if desired.

The rotor 19 includes a core 37 and a generally cylindrical sleeve 39, and the rotor 19 includes a core 41 and a generally cylindrical sleeve 43. The cores 37 and 41 are suitably affixed to the shafts 15 and 17 in any suitable manner such as by keys 45. The sleeves 39 and 43 are removably mounted on annular flanges 49 of their respective cores 37 and 41 in any suitable manner such as by a plurality of screws 47 (three per sleeve being shown in FIG. 2). Each of the peripheral flanges 49 is approximately the same radial dimension as the sleeves 39 and 43. Each of the sleeves 39 and 43 has a generally cylindrical peripheral surface which is particularly adapted to separate and cut the ribbon wire 29.

As shown in FIGS. 10–12, the ribbon wire 29 includes a plurality of conductive wires 51 held together in spaced parallel relationship by a plastic body 53 of insulating material. As shown in FIG. 12, the plastic body 53 includes tubular insulating sections 55 having integral portions 57 for holding the wires 51 and their associated insulations together.

The peripheries of the sleeves 39 and 43 are configured so as to separate and cut the ribbon wire 29 in a particular manner such as illustrated in FIG. 10. As shown at the lower end of FIG. 10, each of the wires has been separated from the adjacent wires over a portion of its length and cut to a particular length. The manner in which the ribbon wire 29 is separated and cut will depend upon extrinsic circumstances, and the peripheries of the sleeves 39 and 43 can be appropriately configured to carry out the desired separating and cutting functions.

The sleeve 39 has a plurality of axially spaced circumferentially extending ribs 59 (FIGS. 3 and 4) formed integrally therewith and separated by axially spaced circumferentially extending grooves 61. Similarly, the sleeve 43 has a plurality of circumferentially extending ribs 63 axially spaced by circumferentially extending grooves 65. The circumferential extent of the ribs 59 and 63 depend upon the length to which the particular wires 51 are to be separated.

FIG. 6 shows, by way of example, the circumferential extent of the ribs 63 on the sleeve 43. For example, a particular rib 63′ extends continuously for the full circumferential dimension of the sleeve 43 except for a gap 67 (FIG. 7) along which the rib 63 has been completely removed. Although the rib 63′ is completely removed at the gap 67, and is therefore discontinuous, it should be understood that the radial dimension of the rib 63′ only need be reduced to the extent necessary to prevent it from separating during the time interval represented by the gap 67, i.e., it only need be effectively discontinuous.

As shown in FIGS. 6 and 7, the rib 63′ has a starting location 69 and a terminus 71. Similarly, the other ribs 63 are discontinuous or effectively discontinuous over portions of their lengths so that each of them has a corresponding starting location 69 and terminus. In FIG. 6, the termini 71 are located at different circumferential points thereby illustrating typical differences in separation length.

The ribs 63 have flats 73 thereon at corresponding circumferential locations as shown in FIGS. 6 and 8. The sleeve 39 has corresponding flats (not shown) and these cooperate to form a starting section 74 which facilitates insertion of one end of the ribbon wire 25 between the sleeves 39 and 43.

In the form shown in FIG. 6 the ribs 63 begin at the starting location 69 and continue to the starting section 74. These short portions of the ribs 63 serve to separate the opposite end portions of the ribbon wire 29 for a distance corresponding to the shortest circumferential distance between starting locations 69 and the starter section 74 or a location in the starter section. Obviously other rib patterns could be provided, and the short rib portions between the starting locations 69 and the starter location 74 could be eliminated if no such separation function were desired. Cutting elements could be provided in the grooves 65 between the start-

ing locations 69 and the starter location 74 if desired.

The cutting function is carried out by a plurality of cutting elements 77 (FIGS. 4–6 and 9) mounted, respectively, on the sleeves 39 and 41. In the embodiment illustrated, each of the cutting elements 77 is in the form of an elongated pin having a sharp cutting edge 79 (FIGS. 5 and 9) at one end thereof. Although other constructions could be employed, in the embodiment illustrated each of the sleeves 39 and 43 contains a plurality of bores 81 (only one per sleeve being shown in FIG. 5) into which one of the cutting elements 77 is press fit. Each of the cutting elements is mounted at a preselected position along a groove rather than along a rib. As shown in FIG. 6, the cutting elements 77 are located in different circumferential positions so that the wires will be cut to the desired lengths. Each of the cutting elements 77 is normally located so that it will sever the associated wire before such wire is fully separated, i.e., prior to the time at which the terminus 71 of the associated rib contacts the wire.

With the sleeves 39 and 43 mounted as shown in FIGS. 3 and 4, the ribs 59 are aligned with the grooves 65, respectively, and the ribs 63 are aligned with the grooves 61, respectively. The axial dimension of each of the grooves 61 and 65 is sufficient to accommodate one of the wires 51. The result is that the ribs and grooves cooperate to offset adjacent wires 51 radially of the sleeves 39 and 43.

In the embodiment illustrated, the ribs 59 and 63 are partially received in the grooves 65 and 61, respectively; however, the radial dimension of the ribs 59 and 63 need only be sufficient to accomplish the necessary radial offset. The radial offset must be sufficient to rupture the integral portions 57 (FIG. 12) of the ribbon wire 29. Specifically, each aligned rib and groove pair cooperates with adjacent rib and groove pairs to shear the integral portions 57 with the lengths of the ribs 59 and 63 controlling the length to which each of the associated wires 51 is separated. Of course, each separated wire has its own insulating section 55 thereon.

In operation of the apparatus 11, the rotors 19 and 21 are arranged with the starter sections 73 thereof in confronting relationship adjacent the feed tray 27, and the ribbon wire 29 is positioned on the feed tray 27 with one end thereof being inserted into the starter section 73. The rotor 21 is then driven either manually by the handle 31 or by the motor 33. The rotor 19 is driven at the same angular velocity as the rotor 21 by the gears 25 and 23. The peripheries of the sleeves 39 and 43 are preferably identical so that the tangential velocities of the two rotors are also identical. The rotors 19 and 21 cooperate to advance the ribbon wire 29 therethrough.

The ribs 59 cooperate with the grooves 65 and the ribs 63 cooperate with the grooves 61 to radially offset the adjacent wires 51 into the grooves 65 and 61, respectively, with the wires being alternately received by the grooves 61 and 65. This shears the integral portions 57 (FIG. 12) with the result that the wires 51 are separated, i.e., severed from the adjacent wires. This separating action for each of the wires 51 begins at the starter section 74 and ends at the terminus 71. In the embodiment illustrated the separating function begins again at the starting location 69 and terminates at or in the starter section 74.

As the rotors 19 and 21 rotate, ultimately one or more of the cutting elements 77 will be brought into an operative position in which it directly confronts the adjacent rotor as shown in FIG. 5. When this happens, the cutting edge 79 is pressed against a region of the wire 51 and the insulation therefor with the result that the wire and its insulation are completely severed. The severed portion of the wire 51 is forced out of the apparatus 11 by the continuing movement of the ribbon wire 29. No separating function occurs when the gap 67 confronts the ribbon wire; however, the trailing end of the ribbon wire is separated by the short rib portions between the starting locations 69 and the starter section 74 or a location in the starter section.

When the ribbon wire has been run completely through the apparatus 11 it is cut and separated in accordance with a preset program. To establish a new program, it is only necessary to remove the sleeves 39 and 43 and replace them with other sleeves having a different pattern of ribs and grooves. It should be understood that the particular pattern of ribs, grooves and cutting elements 77 is merely illustrative and that many different patterns and arrangements can be provided. The apparatus 11 is useful in separating two or more wires of various lengths and diameters.

Although an exemplary embodiment of the invention has been shown and described, many changes, modifications and substitutions may be made by one having ordinary skill in the art without necessarily departing from the spirit and scope of this invention.

We claim:

1 An apparatus for cutting and separating ribbon wire wherein the ribbon wire includes a plurality of wires held together in generally parallel relationship by a severable body, said apparatus comprising:

first and second rotors having first and second peripheral surfaces, respectively;

means for mounting said first and second rotors on said supporting structure for rotation relative thereto about first and second spaced rotational axes, respectively, with regions of said first and second peripheral surfaces being closely adjacent, the ribbon wire being insertable between said rotors at said regions;

means for drivingly connecting said rotors so that said rotors rotate at the same angular velocity;

each of said first and second peripheral surfaces having circumferentially extending ribs and grooves with the ribs of the first and second peripheral surfaces being aligned with the grooves of the second and first peripheral surfaces, respectively, to thereby define a plurality of rib and grooves pairs, each aligned rib and groove pair being adapted to cooperate with an adjacent rib and groove pair to sever said severable body to thereby separate one of said wires from an adjacent wire;

at least some of said ribs being effectively discontinuous so that the associated wires are separated during only a portion of a revolution of the rotor carrying such ribs;

a plurality of cutting elements mounted on at least one of said peripheral surfaces in a position to sever a plurality of the wires at preselected locations; and

at least one of the aligned rib and groove pairs having an initial point at which they are first operative to separate the associated wire and a terminus point at which they are no longer operable to separate such wire, the rib of the last mentioned rib and

groove pair being effectively discontinuous at said terminus point, one of said cutting elements being mounted along one of the groove and the rib of the last mentioned rib and groove pair so that it will sever the associated wire before such wire is fully separated.

2. A cutting and separating apparatus comprising:

a supporting structure;

first and second rotors having first and second peripheral surfaces, respectively;

means for mounting said first and second rotors on said supporting structure for rotation relative thereto about first and second rotational axes, respectively, with regions of the first and second peripheral surfaces generally confronting each other;

each of said peripheral surfaces having circumferentially extending ribs and grooves with the ribs of the first and second peripheral surfaces being generally aligned with the grooves of the second and first peripheral surfaces, respectively;

at least two of said ribs on one of said rotors being at least partially interrupted at different circumferential locations on said one rotor;

said first rotor having end grooves adjacent the opposite ends of the first rotor and at least one intermediate groove located axially intermediate said end grooves; and

a cutting element mounted in said intermediate groove of said first rotor.

3. An apparatus for cutting and separating ribbon wire wherein the ribbon wire includes a plurality of wires held together in generally parallel relationship by a severable body, said apparatus comprising:

first and second rotors having first and second peripheral surfaces, respectively;

means for mounting said first and second rotors on said supporting structure for rotation relative thereto about first and second spaced rotational axes, respectively, with regions of said first and second peripheral surfaces being closely adjacent, the ribbon wire being insertable between said rotors at said regions;

means for drivingly connecting said rotors so that said rotors rotate at the same angular velocity;

each of said first and second peripheral surfaces having circumferentially extending ribs and grooves with the ribs of the first and second peripheral surfaces being aligned with the grooves of the second and first peripheral surfaces, respectively, to thereby define a plurality of rib and groove pairs, each aligned rib and groove pair being adapted to cooperate with an adjacent rib and groove pair to sever said severable body to thereby separate one of said wires from an adjacent wire;

at least some of said ribs being effectively discontinuous so that the associated wires are separated during only a portion of a revolution of the rotor carrying such ribs;

a plurality of cutting elements mounted on at least one of said peripheral surfaces in a position to sever a plurality of the wires at preselected locations, at least some of said cutting elements are in said grooves; and

said first rotor including a core and a sleeve and means for removably mounting the sleeve on the core, said sleeve having said peripheral surface of said first rotor thereon.

4. An apparatus as defined in claim 1 wherein said one cutting element is mounted in one of said grooves.

5. An apparatus as defined in claim 2 including drive means for drivingly interconnecting said rotors to thereby cause said rotors to rotate together.

6. An apparatus as defined in claim 2 including a rotatable shaft and wherein said first rotor includes a core mounted on said shaft, a sleeve, and means for removably mounting said sleeve on said core, said sleeve having said grooves and ribs of said first rotor thereon.

7. An apparatus as defined in claim 2 wherein said first rotor includes a core and a sleeve mounted on said core, said cutting element including a pin having a cutting edge mounted on said sleeve and projecting generally radially thereof.

8. An apparatus as defined in claim 1 wherein the circumferences of said rotors are substantially equal and said rotational axes are substantially parallel.

* * * * *