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Erlichman et al.

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[54] **METHOD AND APPARATUS FOR MAKING ANGLE SPARK PLUG TERMINALS**

[75] Inventors: **Stanton Roy Erlichman,** Villanova; **Harold Woolf, Norman Baker,** both of Philadelphia, all of Pa.

[73] Assignee: **Richards Manufacturing Company,** Philadelphia, Pa.

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[52] **U.S. Cl.**..... **29/203 D,** 29/203 DT, 29/203 DTS, 29/629, 29/630, 29/630 A

[51] **Int. Cl.**..... **H01r**

[58] **Field of Search**..... 29/629, 630, 630 A, 29/203 D, 203 DT, 203 DTS

[56] **References Cited**

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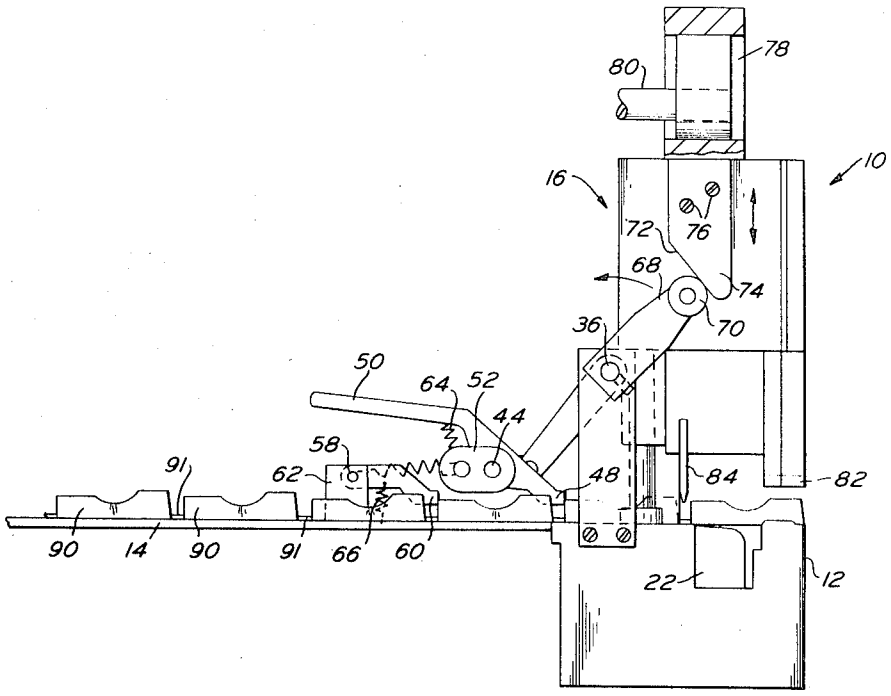
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Primary Examiner—Charles W. Lanham
Assistant Examiner—James R. Duzan
Attorney—Arthur A. Jacobs

[57] **ABSTRACT**

A method and apparatus for forming angle spark plug terminals, whereby the end of a cable is inserted into an open portion of a two-part integral terminal unit comprising an open portion and a closed cylindrical portion separated by an undercut bridge portion. A vertically movable die means acts to crimp the open portion of the unit around the cable and simultaneously forces a detent into the cable to connect the cable to the terminal unit. The die means also simultaneously effects a bending of the closed portion around the bridge portion into a predetermined angle relative to the remainder of the assembly. The terminal units are initially formed in a strip with connecting means therebetween in order to provide effective linear feed movement of the terminal units. Simultaneously with the coupling, crimping and bending of each assembly, the next preceding assembly is severed therefrom, through the connecting means, by the same movement of the die means.

5 Claims, 9 Drawing Figures



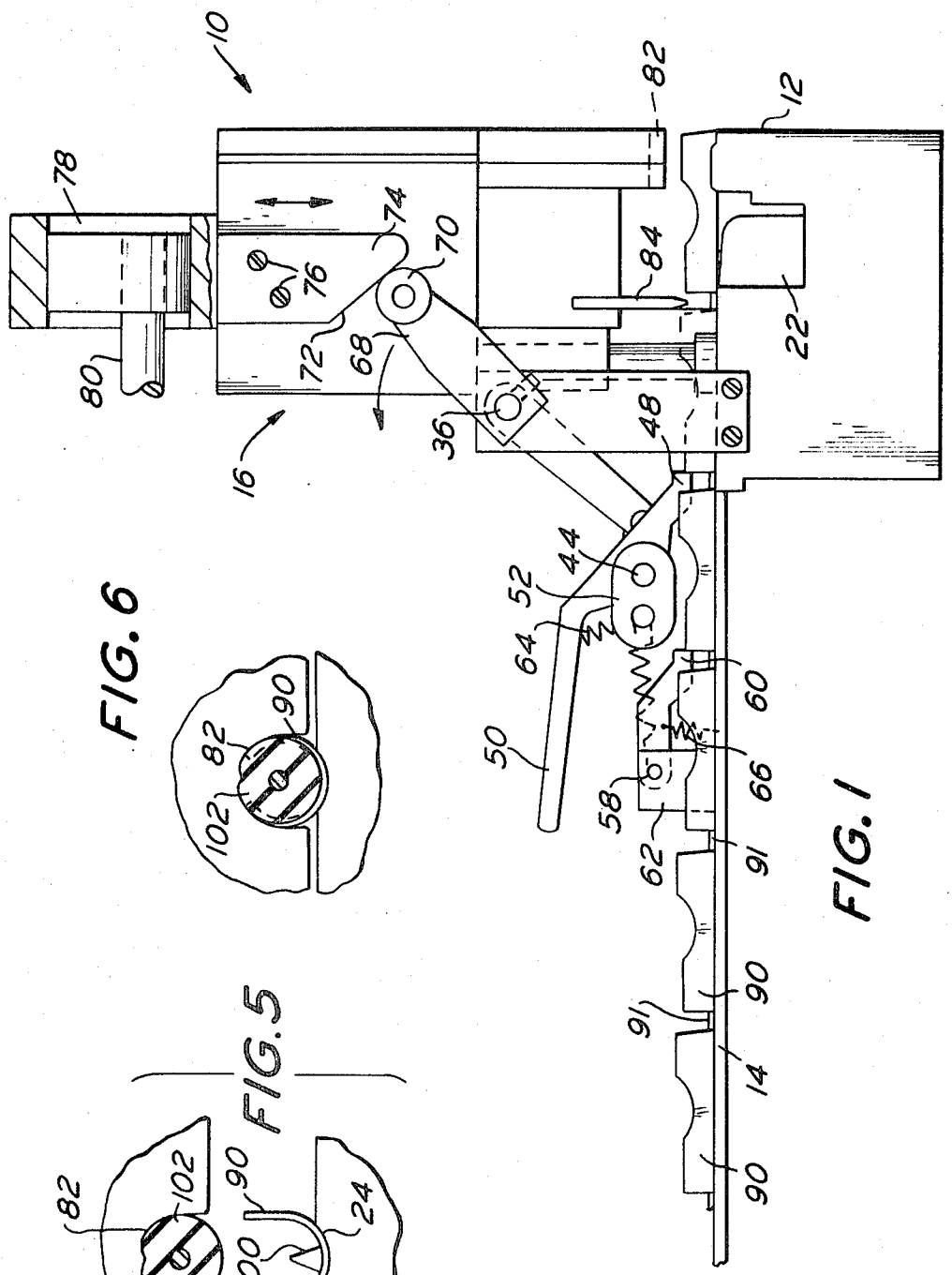
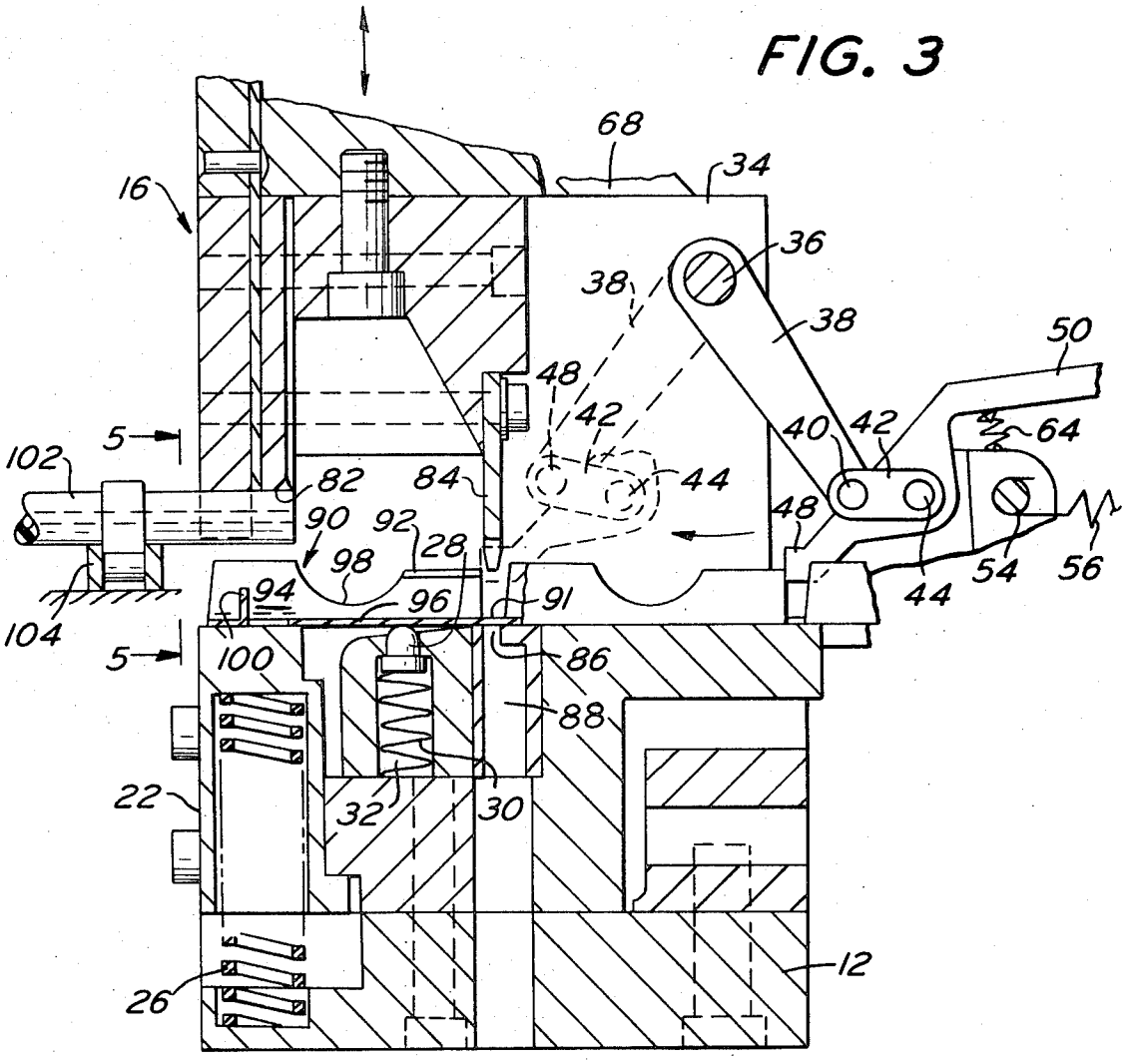


FIG. 1

FIG. 6

FIG. 5

FIG. 3


68
34
16
36
38
38
50
48
42
40
42
64
5
102
82
84
44
48
90
92
28
98
94
96
91
54
56
44
104
5
100
86
88
22
32
30
26
12

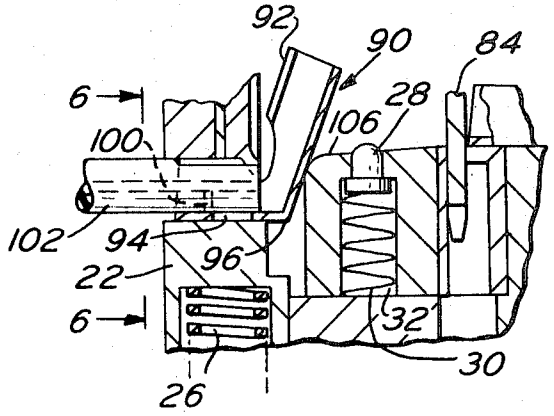

92
90
84
6
28
106
100
102
94
96
22
6
32
30
26

FIG. 4

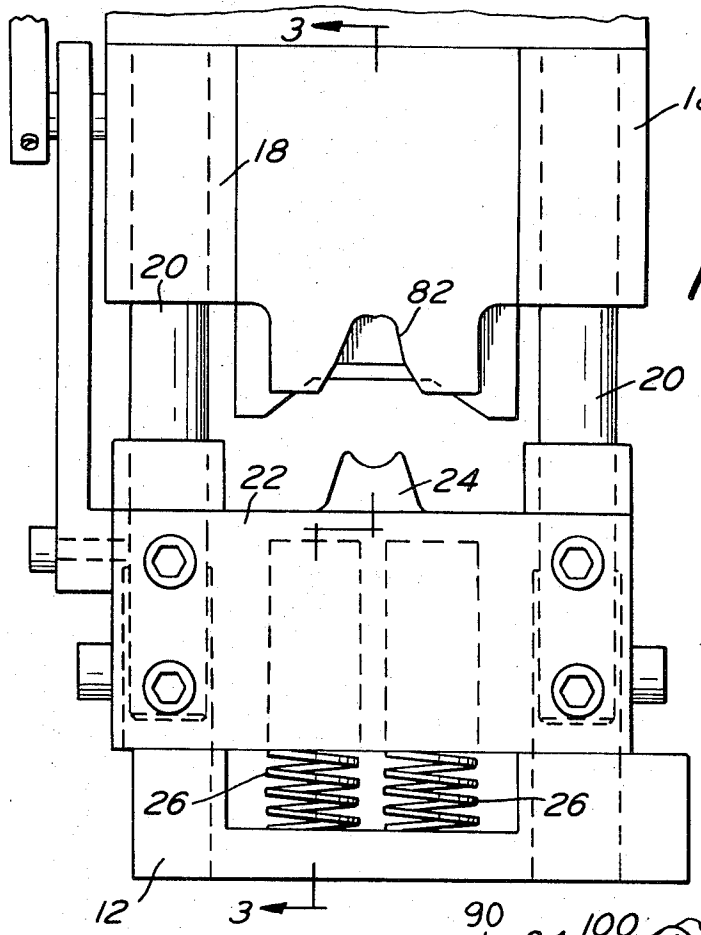


FIG. 2

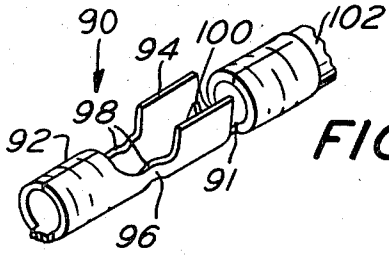


FIG. 7

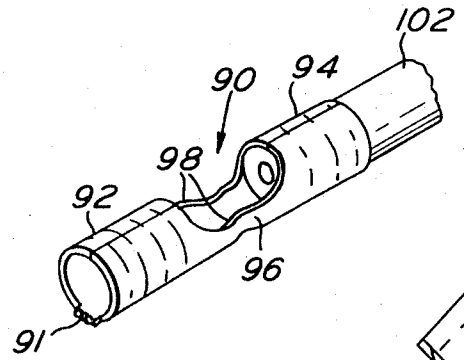


FIG. 8

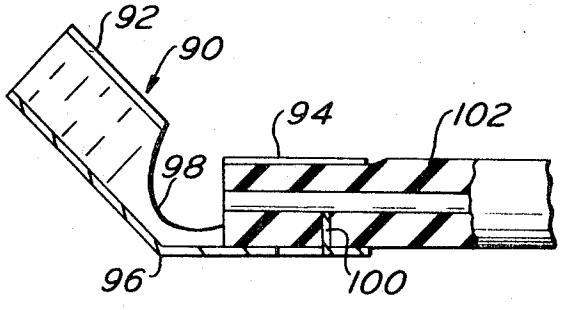


FIG. 9

METHOD AND APPARATUS FOR MAKING ANGLE SPARK PLUG TERMINALS

This invention relates to a method and apparatus for making angle spark plug terminal assemblies, and it particularly relates to such method and apparatus wherein the terminal is simultaneously connected to the electrical cable and bent into the desired angle.

In most modern automotive vehicles, the area under the hood is greatly crowded with various types of mechanisms so that space is at a premium. For this reason, it is not possible to use a spark plug terminal assembly where the terminal is axially aligned with the cable since it would then be difficult if not impossible to find room for maneuver of the cable while attaching the terminal to the spark plug. It has been found that this difficulty can be obviated by attaching the terminal to the cable in an offset position so that it can be moved laterally into position on the spark plug.

In order to form such offset terminal assemblies, it was heretofore generally necessary to use at least two or, sometimes, more than two, separate operations, whereby the cable is first attached to the terminal and then the terminal is bent into the desired offset position. This increased both the cost of labor and the time involved in producing these assemblies; especially since no machinery was available to effectivey and automatically carry out these steps.

It is one object of the present invention to provide a method and apparatus which is capable of attaching the terminal to the cable and simultaneously bending the terminal into the desired offset position in a single stage.

Another object of the present invention is to provide a method and apparatus of the aforesaid type which is relatively simple in operation and construction and which is relatively inexpensive, requiring a minimum of operating technique on the part of the worker and a minimum of machinery to accomplish the purpose.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following description when read in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view of a machine embodying the present invention.

FIG. 2 is a fragmentary front elevational view of the machine of FIG. 1.

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2.

FIG. 4 is a fragmentary sectional view showing the manner of bending the terminal.

FIG. 5 is a fragmentary view, partly in section and partly in elevation, taken on line 5—5 of FIG. 3, showing the initial step of connecting the terminal to the cable.

FIG. 6 is a view, taken on line 6—6 of FIG. 4, showing the second step.

FIG. 7 is a fragmentary perspective view showing the terminal units connected in a strip thereof, and showing a cable end prior to assembly.

FIG. 8 is a fragmentary perspective view showing the assembled terminal and cable prior to bending of the terminal.

FIG. 9 is a fragmentary sectional view of the angle spark plug completed terminal assembly.

Referring now in greater detail to the various figures of the drawings wherein similar reference characters refer to similar parts, there is shown in FIG. 1 a machine, generally designated **10**, comprising a base **12** having a table **14** extending laterally therefrom. The base **12** is provided with a flat surface over which the terminal blanks (hereinafter more fully described) move.

A vertically movable die mechanism, generally designated **16**, is provided with sleeve portions **18** (note FIG. 2) which slidably embrace corresponding guide posts **20** extending upwardly from the base **12**.

The base **12** is provided with a vertically slidable support plate **22** having a concave anvil portion **24** at its upper end, (see FIG. 2). The plate **22** is biased upwardly by springs **26**. Laterally spaced from the anvil **24** is a stop member **28**, (see FIG. 3) which is biased upwardly by a spring **30** positioned in a channel **32**.

Forwardly of the die mechanism **16** are spaced walls **34** which support a rotatable shaft **36**. Mounted on this shaft **36** is the upper end of an arm **38** which, at its lower end, is pivotally connected at **40** to a link **42**. The link **42** is, in turn, pivotally connected at **44** to a lever **46** which is integral with a finger **48** at one end and with a handle **50** at the other end.

Also mounted on the pin **44** is a link **52** to which is connected, as at **54**, one end of a spring **56**. The other end of spring **56** is connected to a rotatable shaft **58** which pivotally connects a finger **60** to a bracket **62** mounted on the table **14**. A spring **64** is positioned between the handle **50** and the link **52**, while a spring **66** is positioned between the finger **60** and the table **14**.

Mounted on the shaft **36**, coaxially with the arm **38**, is a lever **68** which, at its upper end, is provided with a cam follower roller **70**. The roller **70** is arranged to bear against a cam surface **72** of a cam **74** connected at **76** to the die mechanism **16**. Also connected to the die mechanism **16** is a ring **78** through which extends an eccentric shaft **80** eccentrically connected to an electric motor or the like (not shown). The shaft **80**, as it rotates around an arc, acts as a crank arm whereby it contacts the upper portion of the ring **78** during one portion of its movement to lift the die mechanism, together with the cam **74**, upwardly, while during another portion of its movement it contacts the lower portion of the ring to press the die mechanism downwardly.

The die mechanism **16** includes a concave, semicircular die portion **82** (note, particularly, FIGS. 5 and 6) and a downwardly-depending blade **84** laterally spaced from the die portion **82**. The blade **84** is movable into and out of an aperture **86** integral with a channel **88** in the base **12**.

The terminal units, designated **90**, prior to insertion in the presently described machine, are formed connected together in a continuous strip by means of connecting portions **91** (note, especially, FIG. 1). In this manner, they can be fed continuously through the machine. The units, themselves, comprise a closed tubular portion **92** and an open portion **94**, the two portions being connected by a bridge portion **96** defined by recesses **98**, whereby this bridge portion is sufficiently reduced in section to bend easily without breaking. A prong **100** is struck up from the bottom of the portion **94**.

The individual lengths of cable **102** are arranged laterally on any appropriate conveyor mechanism such as a chain conveyor or the like, indicated at **104** (note

FIG. 3), and are fed by said conveyor into operative position, as shown in FIG. 3, in timed relationship with the vertical movement of the die mechanism. This timed relationship may be obtained in any standard manner, such as by appropriate gearing or the like, connected to the motor which actuates the crank arm shaft **80.**

The end portions of the cables **102** are individually moved into the die cavity **82** in overlying relationship to the open portion **94** of a corresponding terminal unit **90** held in the complementary anvil **24.** The die mechanism **16** is then caused to move downwardly to compress the open portion **94** around the cable. At the same time, the prong **100** is pushed into the cable to form an interlock and a positive electrical connection between the terminal unit and the cable insulation.

While the compressive force of the die mechanism is taking place, the plate **22,** although initially biased upwardly by the springs **26** with sufficient force to enable compression of the portion **94** and engagement of the prong **100** to be effected, is thereafter pushed downwardly, against the force of the springs **26,** for a suifficinet distance to cause a bending to take place in the bridge portion **96** (see FIG. 4), the shoulder **106** acting as an anvil to effect such bending. In this manner, the terminal unit is both applied to the cable and bent into the desired shape at the same time.

The terminal units are fed into the machine in timed relationship with the movement of the conveyor **104** by means of the finger **48** which intermittently is actuated through the link **42** and the arm **38** to move into position behind one of the terminal units, push the unit forwardly into the die area, and then retract to engage the rear end of the next succeeding unit. This movement of the finger **48** is effected by movement of the crank arm shaft **80.** In operation, when the crank shaft moves to raise the die mechanism **16,** it moves the cam **74** upwardly, thereby permitting the spring **56** to retract the finger **48.** When the crank shaft moves to lower the die mechanism **16,** the cam surface **72** bears down against the follower roller **70** during the initial portion of the downward travel, and, thereupon, actuates the lever **68** and its connecting linkage to engage the finger **48** with the terminal unit and push it forwardly. This action is completed by the time the die portion **82** is in operative position. Upon upward movement of the die mechanism, the cam moves upwardly and the finger **48** is permitted to be retracted by the spring **56.**

Upon completion of the spark plug terminal assembly, the assembled unit is moved into the next position upon further actuation of the finger **48.** Thereupon, with the succeeding downward movement of the die mechanism, the cutoff blade **84** is moved downwardly to sever the finished assembly from the following unit by slicing through the connecting portion **91.** In order to prevent kickback resulting from the severing action, the finger **60** is biased by spring **66** to abut the rear end of the next succedding terminal unit.

The handle **50** is provided as an auxiliary manually-operable device to prevent jamming of the machine. If jamming should occur, the handle **50** is pushed down, against the bias of the spring **64,** whereby the finger **48** is retracted and feeding is halted until the jammed piece can be removed.

The invention claimed is:

1. A machine for forming and assembling angle spark plug terminals comprising a base, a first anvil on said base, said anvil being movable relative to said base and being resiliently biased into a predetermined position, a die means operatively connected to said base and movable toward and away from said base, reciprocating means operatively connected to said die means for moving said die means toward and away from said base, a die portion on said die means, said die portion being in alignment with said first anvil and being generally complementary thereto, a second anvil rigidly connected to said base and being laterally spaced from said first anvil, a blade connected to said die means and being laterally spaced from said second anvil, a feed table operatively connected to said base, said feed table extending from said base transversely to the direction of movement of said die means, said feed table being constructed and arranged to support a linear strip of terminal units during linear feed movement of said strip toward said die means, said strip comprising a series of terminal units connected to each other by severable connecting portions, feed means operatively connected to said die means, said feed means being constructed and arranged to intermittently move successive terminal units of said strip between said die portion and said first anvil in timed relation with the reciprocating movement of said die means, conveyor means constructed and arranged to bring successive cables into position within said die portion while said die portion is spaced from said first anvil and while a first portion of a terminal unit is positioned on said first anvil, said die means being constructed and arranged to bring said die portion and a cable held thereby against said first portion of said terminal unit while said first portion is positioned on said first anvil, and while it is integral with said linear strip, with sufficient force to crimp said first portion of said terminal unit around said cable while simultaneously depressing said first anvil against its resilient bias, said second anvil being constructed and arranged to rigidly support a second portion of said terminal unit during the depression of said first anvil whereby said second portion is bent relative to said first portion to form an angle terminal assembly, and said blade being constructed and arranged to simultaneously sever a preceding terminal assembly from that being formed.

2. The machine of claim **1** wherein said feed means comprises a finger constructed and arranged to abut the rear ends of successive terminal units and being connected by operative linkage to a cam follower, said cam follower being in engagement with a cam, said cam being reciprocably movable relative to said base in conjunction wiht said die means, said cam being constructed and arranged to act through said cam follower and linkage to move said finger toward said first anvil during initial movement of said die means toward said base, and biasing means resiliently urging said finger in the opposite direction.

3. The machine of claim **2** wherein said finger is provided with a manually actuatable handle constructed and arranged to withdraw said finger from abutment against a terminal unit, said handle being resiliently biased against the withdrawal of said finger.

4. The machine of claim **2** wherein a second pivoted finger is positioned on said table in linearly spaced relation to said first-mentioned finger, the spacing therebetween corresponding to the length of a terminal unit, said second finger being constructed and arranged to abut against the rear end of the next succeeding terminal unit to prevent kickback during severance of a completed assembly.

5. The machine of claim **1** wherein said reciprocating means is a crank shaft connected to an acutating motor.

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