

[54] **AIR OPERATED TERMINAL FEED DEVICE**

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[51] Int. Cl. **H05k 13/04, B23q 7/10**

[58] Field of Search **29/203 B, 203, 211**

[56] **References Cited**

UNITED STATES PATENTS

3,524,240 8/1970 Walker et al. **29/203 B**

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[57] **ABSTRACT**

An air operated terminal feed device, for use with an insertion machine, to transport prefabricated terminals into position for insertion in a workpiece, which includes a supply of terminals separately encapsulated in a continuous supply tape. The tape may be perforated to cooperate with sprockets on a cylindrical drive wheel actuated by a pawl and ratchet mechanism, to move the tape incrementally toward a reciprocating die or punch which separates the encapsulated terminals from the tape. A pneumatic cylinder is provided as a power source to actuate the pawl and ratchet mechanism. A take-up wheel, which is operably connected to the drive wheel and upon which the perforated tape is wound, may be provided as an aid in maintaining proper tension in the tape.

5 Claims, 7 Drawing Figures

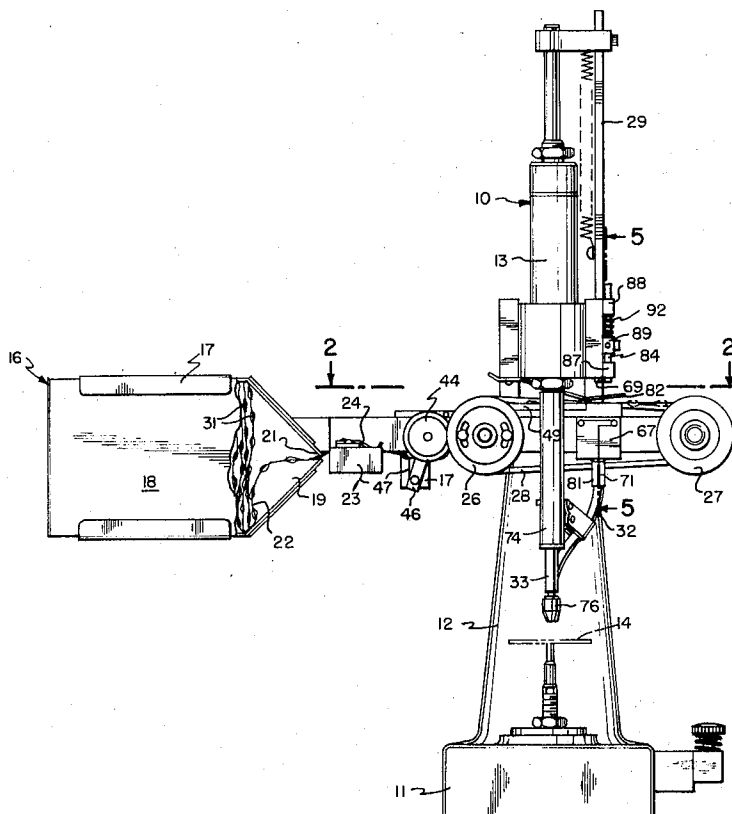
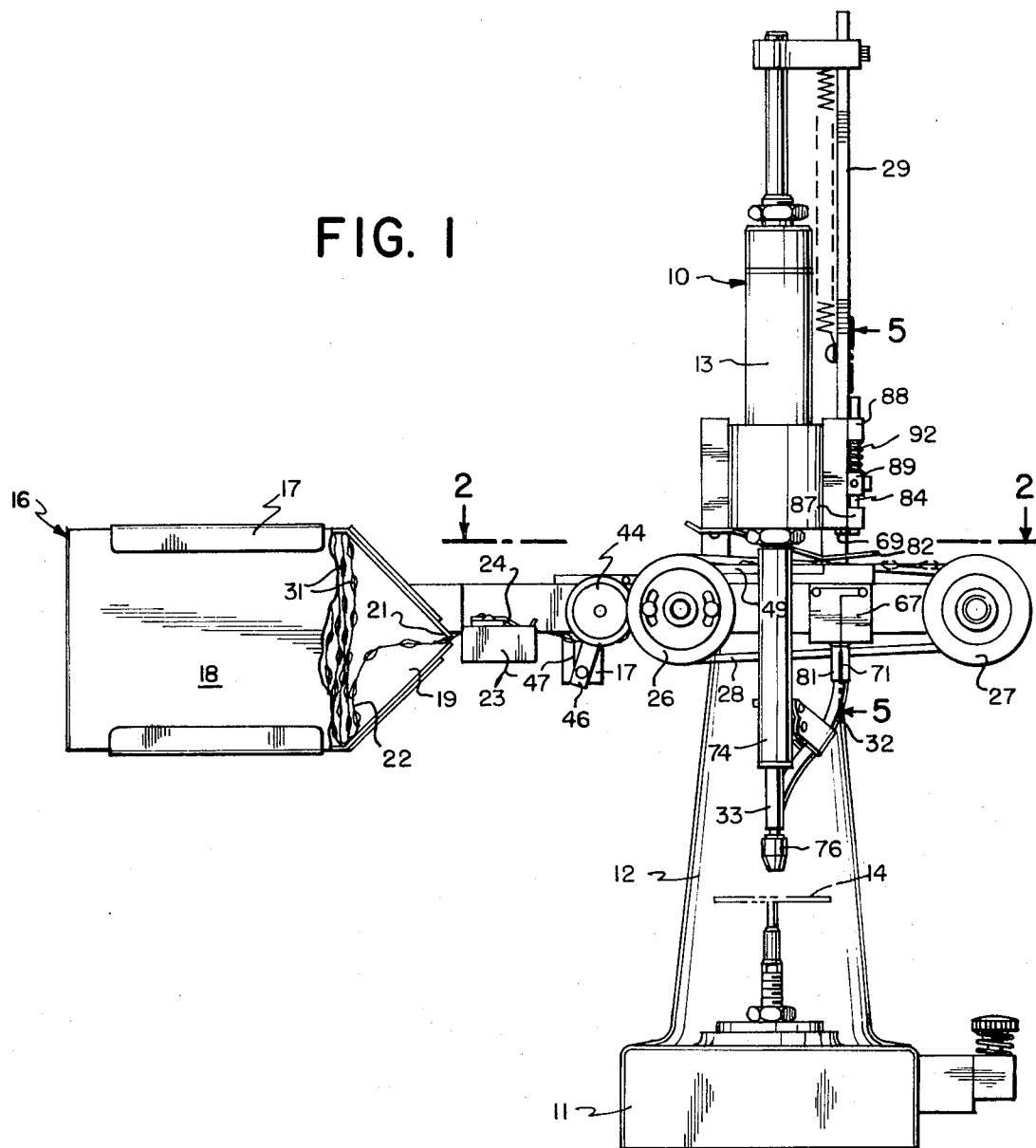


FIG. 1



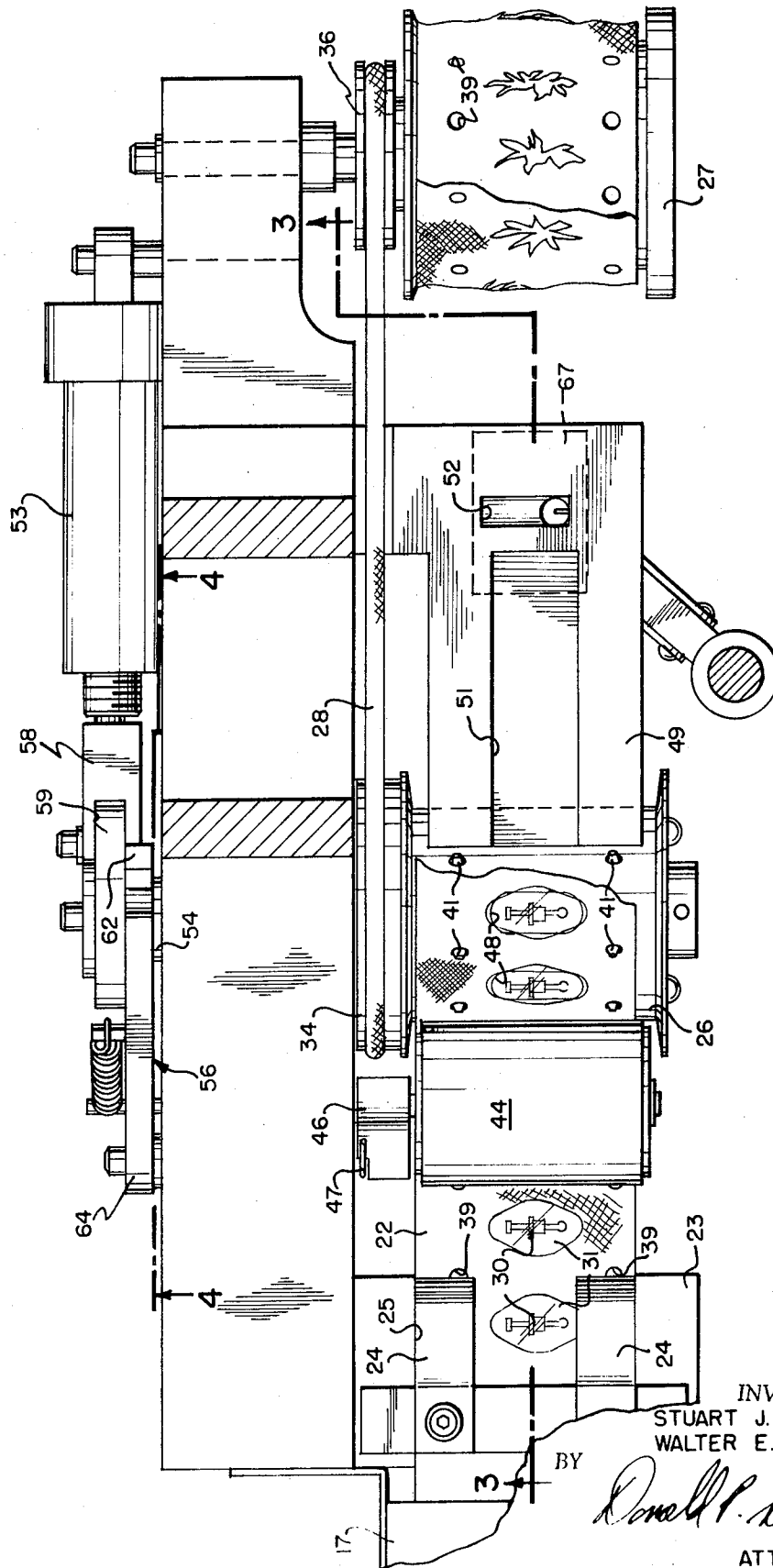
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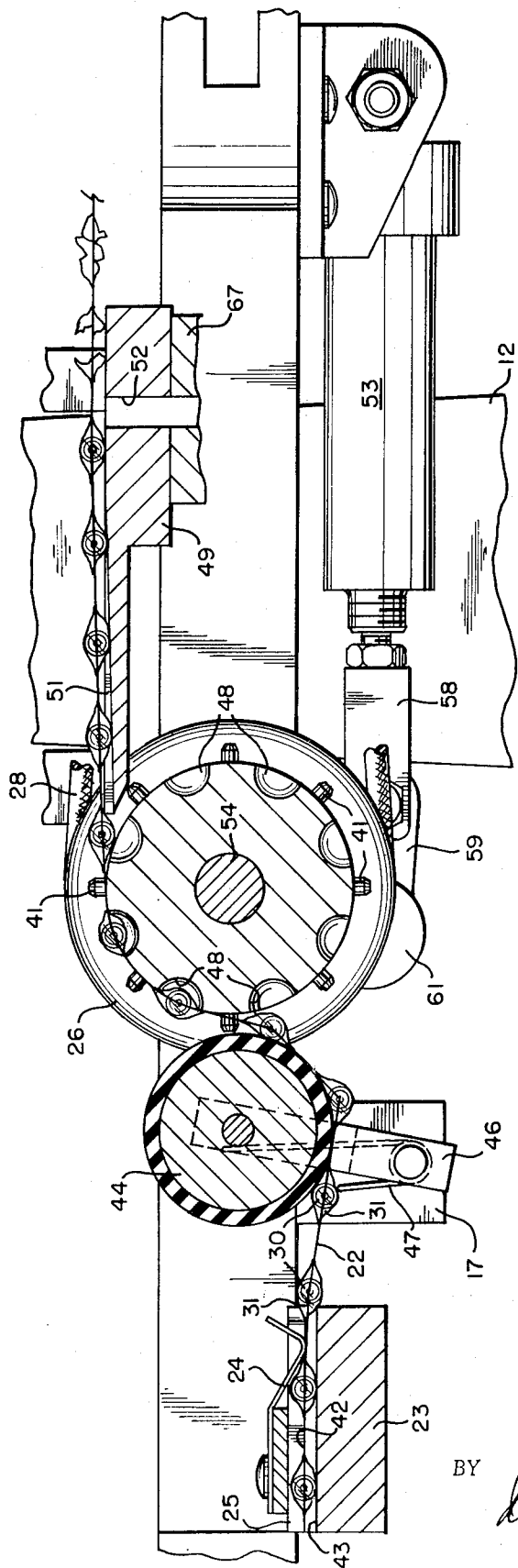
FIG. 2



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FIG. 3



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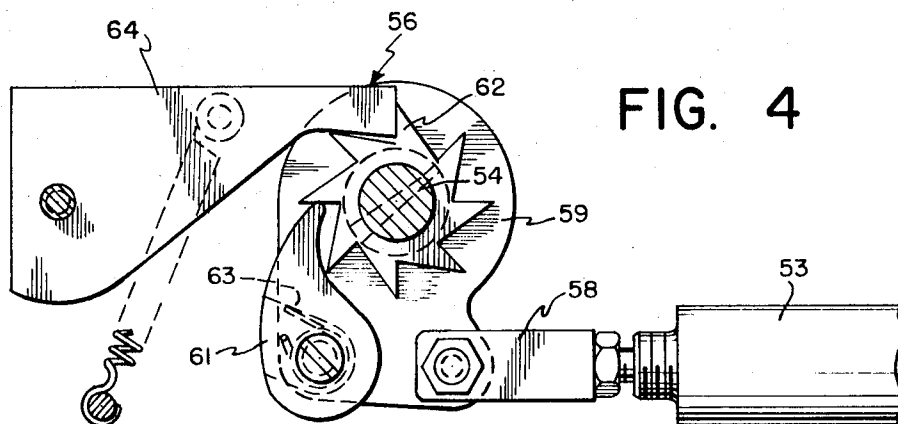


FIG. 4

FIG. 5

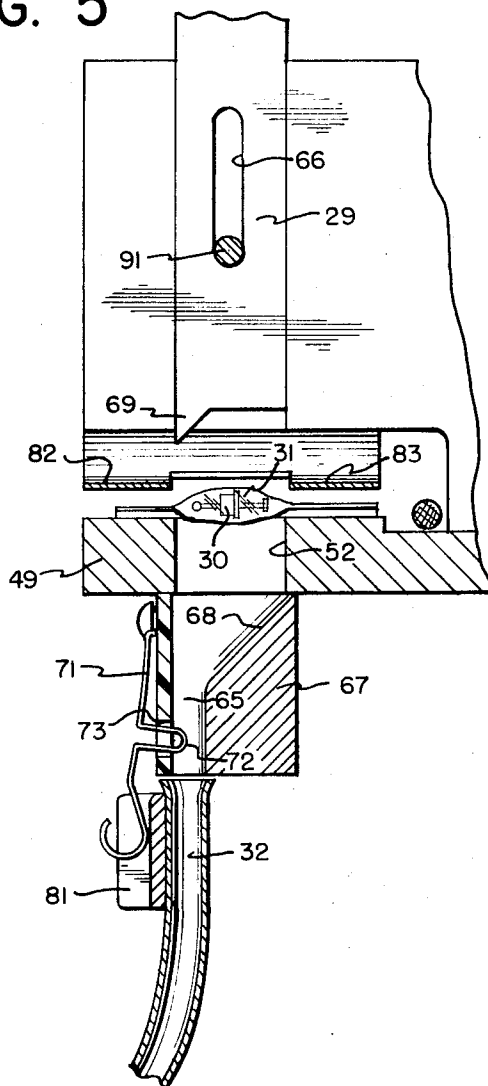
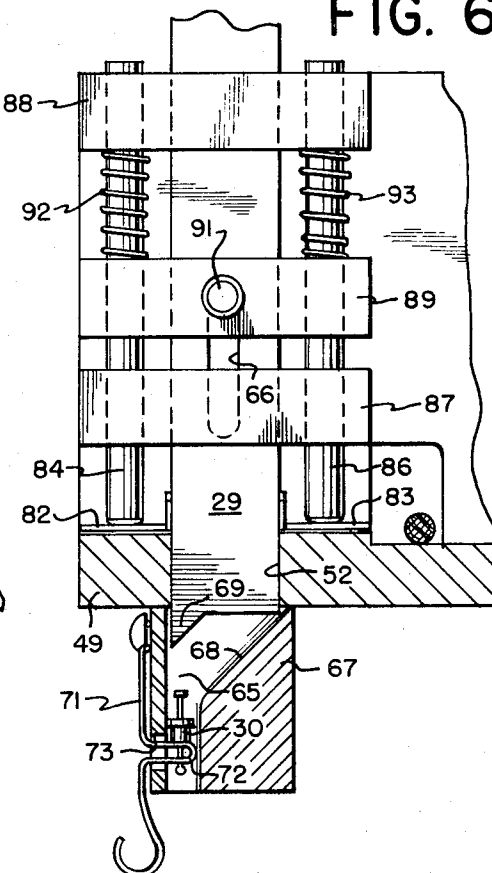


FIG. 6



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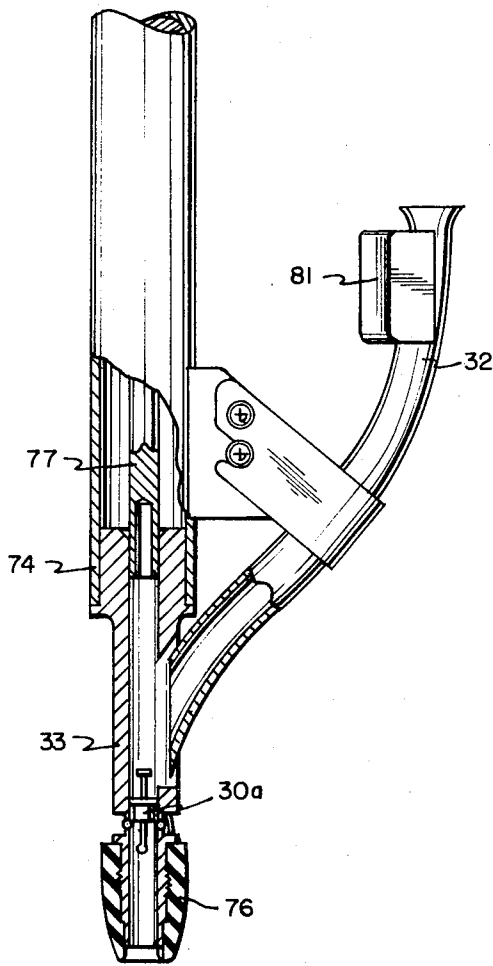
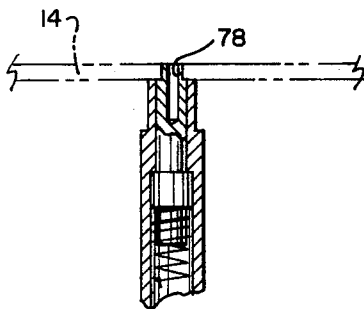


FIG. 7



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AIR OPERATED TERMINAL FEED DEVICE**BACKGROUND OF THE INVENTION**

The invention relates generally to devices for inserting terminals into circuit elements or workpieces, and more particularly to automatic feed devices for such machines by which prefabricated terminals may be fed continuously to the machine for insertion into a workpiece.

Heretofore techniques for inserting a series of terminals in the holes of a workpiece, such as a circuit board, have been inefficient and unsatisfactory for the reason that the dexterity and proficiency of an operator of the machine has been found to be a limiting factor with respect to the number of terminals that can be installed in a given period of time.

BRIEF DESCRIPTION OF THE INVENTION

The present invention uses a pre-packaged supply of terminals encapsulated individually in pockets in a continuous flexible tape or strip of cellophane or other suitable material. The terminals are of generally cylindrical shape with an axial length greater than the diameter of the largest part and are encapsulated with their axes perpendicular to the length of the strip. They must all be oriented in the same direction since they must be inserted in the same direction in the workpieces. A pneumatic cylinder may be provided to actuate a pawl and ratchet mechanism operably connected to a pair of cylindrical wheels which serve to extract the tape from the package. The tape carrying the encapsulated terminals may therefore be transported intermittently into the operating path of a reciprocating operator which successively punches the terminals out of the pockets and into a guide tunnel which serves to orient them in a predetermined position for insertion by the machine. It may be seen therefore that the speed with which terminals may be inserted into circuit boards or workpieces need not depend upon the abilities of the particular person responsible for operating the machine.

Accordingly, it is one object of the present invention to provide an air operated feed device for use with an insertion machine to guide terminal components into position automatically for insertion in a workpiece.

Another object of the present invention is to provide an air operated terminal feed device which is relatively simple and economical to produce.

Still another object of the present invention is to provide an air operated terminal feed device which may be attached to or removed from an insertion machine with a minimum of effort.

BRIEF DESCRIPTION OF THE DRAWINGS

For a further understanding of the present invention, reference may be had to the accompanying drawings, in which:

FIG. 1 is a plan view of an air operated insertion machine having attached thereto the automatic terminal feed device of the present invention;

FIG. 2 is a section view taken along the line 2—2 of FIG. 1;

FIG. 3 is a section view taken along the line 3—3 of FIG. 2;

FIG. 4 is a section view taken along the line 4—4 of FIG. 2;

FIG. 5 is a section view taken along the line 5—5 of FIG. 1, and showing the present device in a pre-actuated position;

FIG. 6 is an end view similar to FIG. 5 of a portion of the device illustrated in FIG. 1, and shows the feed device in its actuated position; and

FIG. 7 is an elevational view, partly in section, showing the inserting portion of the insertion machine in its preactuated position.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIG. 1, wherein there is illustrated an air operated terminal insertion machine, generally denoted by reference numeral 10, which includes a base 11 and an integral curved support arm 12 that carries at its outer end a double-acting pneumatic cylinder 13. Cylinder 13 actuates a pushrod (not shown) to engage a prepositioned terminal and to force it into frictional engagement with an opening in a circuit board or workpiece 14. It should be noted that the automatic terminal feed device, generally denoted by reference numeral 16, is illustratively connected to the machine 10 and that the present invention is not intended to be limited by the particular combination illustrated, since any insertion machine having suitably proximate air pressure lines for connection to the present invention, may be employed.

The device 16 includes a frame portion 17 designed to support a box-like container 18 which contains the supply of prefabricated terminals. Container 18 may be of any suitable shape, however it is illustratively shown for present purposes to be provided with a V-shaped end 19 having an orifice 21 at its apex through which the terminal supply tape 22 is to be withdrawn, as will be more fully described below.

Also connected to the frame 17 is a block 23 having a plurality of resilient guide members, or fingers, 24 to press against edges of the supply tape 22 to maintain the tape in contact with a guide groove 25 for the purpose of properly orienting the tape with respect to the remaining components of the feed mechanism.

Driving action for the present invention is provided by a pair of cylinders 26 and 27, which are operably connected together by a drive belt 28 which fits over a pair of pulleys to be more fully described below. The cylinder 26 is provided with a plurality of sprockets for the purpose of engaging the supply strip 22 to withdraw the tape from its container 18 and urge it toward the take-up cylinder 27 across the path of a reciprocating punch 29 which separates individual terminals 30 from pockets 31 in the strip 22 in which they have been previously encapsulated. The perforated strip 22 is wound up on the take-up cylinder 27 to maintain sufficient tension in the strip between the two cylinders 26 and 27 so that the perforating process may be efficiently and accurately performed by the punch 29. Upon being separated from the strip 22, an individual terminal will be urged through the trough or funnel 32 and into a pre-actuating position at the end 33 of the inserter portion of the machine 10. It should be noted, that it is convenient to connect the punch 29 to the rod 35 extending from the pneumatic cylinder 13 so that upon actuating the machine 10 to insert a terminal poised at the end 33 into the workpiece 14, the

downward longitudinal movement initiated by actuation of the cylinder 13 will cause the punch 29 to descend along with the pushrod and, simultaneously with insertion of a terminal, the punch will press another terminal 30 from the strip 22. The latter terminal is one that was enclosed in the next pocket which has been positioned beneath the punch by incremental rotation of the drive cylinder 26. This newly-separated terminal then proceeds through the funnel 32 into position at the inserter end 33 as the double-acting cylinder 13 withdraws the pushrod and the punch 29 to pre-actuation position.

In FIG. 2 there is illustrated a sectional view of the drive mechanism of the present invention, wherein there is included, as mentioned above, the drive cylinder 26 and the take-up cylinder 27 which is operably connected to the cylinder 26 by the drive belt 28 stretched between a pair of pulleys 34 and 36 attached to the cylinders 26 and 27 to rotate therewith.

FIG. 2 shows the supply strip 22 and the driving mechanism therefor in greater detail. The strip 22 has a set of sprocket holes 39 spaced along each side thereof to engage sprockets 41 on the cylinder 26. The sprockets 41 form the means by which the supply tape 22 is extracted from its container 18 and transported in fixed, incremental steps across the operating path of the reciprocating punch 29 and from there to the take-up cylinder 27. As has been described above, after passing through the orifice 21 the supply tape 22 passes over the retainer block 23 and is engaged by the spring fingers 24 which press the tape against the surface of the block 23.

The groove 25 in the retainer block may be seen in FIG. 3 to consist of two levels, a first level 42 upon which the side portions of the tape pass under pressure from the spring fingers 24, and a second level 43 which establishes space for the passage of the pockets 31. After passing over the retainer block 23, the supply strip 22 is then threaded under a pressure roller 44, which may be seen in FIGS. 1-3, and over the drive cylinder 26 so that it passes between the inside surface of the pressure roller 44 and the outside surface of the cylinder 26. To assist the threading procedure, the roller 44 is rotatably mounted on a support arm 46 which is pivotally connected to the frame 17 to allow the roller 44 to pivot away from the cylinder 26 during the threading process. A spring 47 biases the support arm 46 so that the roller 44 will continuously press the supply tape 22 against the surface of the cylinder 26. The roller 44 may be constructed of any suitable material, however it has been found that a soft rubber composition is most effective for present purposes.

It may be seen from FIG. 3, that the surface area of the drive cylinder 26 contains a plurality of cavities 48 which have been spaced precisely to accommodate the pockets 31 of the supply tape 22 as the latter is transported across the drive cylinder toward the take-up cylinder 27. The purpose of the second level 43 and the cavities 48 is to insure that there will not be any unnecessary pressure applied to the pockets 31 which might perforate these pockets and prematurely release the terminals. The pressure roller 44, in combination with the spring fingers 24 of the retainer block 23, serves to establish sufficient pressure on the edges of the tape between these points of contact to minimize

the possibility of any misalignment between the holes 39 and the sprockets 41. After departing from the cylinder 26, the tape is supported by a substantially flat stripper plate 49 which contains a guide groove 51, seen in FIGS. 2 and 3, for easing the transition of the pockets from the level of the surface area of the cylinder 26 up to the point of intersection with the reciprocating punch 29. That position of intersection is denoted by the presence in the plate 49, of a channel 52, which will be more fully described hereinafter, but which may be seen in FIG. 2 to have dimensions appropriate for receiving a terminal 30 released from its pocket 31, as will be more fully described below.

As shown in FIG. 2, the cylinder 26 is actuated by a pneumatic cylinder 53 which is connected to the drive shaft 54 of the cylinder 26 through a pawl and ratchet combination generally denoted by reference numeral 56, and which will be more fully described hereinafter in connection with FIG. 4. The take-up cylinder 27 is connected to the cylinder 26 by means of the drive belt 28 which extends between the pulleys 34 and 36. The purpose of the take-up cylinder 27 is to maintain sufficient tension in the tape between these two wheels to minimize any possibility of misalignment with respect to the channel 52. It may be seen from FIG. 2 that the pulley 36 has a somewhat smaller diameter than does the pulley 34, the purpose of which is to maximize the response of the cylinder 27 to any motion imparted to the cylinder 26. It has been found that as the effective diameter of the take-up cylinder increases, owing to the continuous addition of perforated tape, the sensitivity of its response to the movement of the cylinder 26 would gradually diminish and therefore a friction clutch has been provided between the pulley 36 and the drive shaft 57 of the cylinder 27 for the purpose of effectively maintaining an even pressure on the tape while it is in the critical area between the cylinders 26 and 27.

In FIG. 4, there is illustrated one embodiment of a pawl and ratchet mechanism effective to actuate the cylinder 26 in incremental steps of equal length to position each pocket 31 of the supply tape 22 accurately over the channel 52 for removal of each terminal 30. The pneumatic cylinder 53 is connected to a clevis 58 which pivots a guide plate 59 journaled on the drive shaft 54 of the drive cylinder 26. The plate 59 carries an actuating pawl 61 which cooperates with a ratchet wheel 62 non-rotatably attached to the shaft 54. The actuator pawl 61 is biased against the ratchet wheel 62 by a spring 63. It may be seen, therefore, that actuation of the pneumatic cylinder 53 will cause the plate 59 to rock clockwise around the drive shaft 54, which movement will carry the actuator pawl 61 into the ratchet wheel 62 thereby to rotate the latter, and consequently the drive shaft 54 and its cylinder 26, a predetermined distance. A keeper pawl 64 is provided to cooperate with the ratchet wheel 62 for the purpose of engaging the latter at the completion of any stroke by the actuator pawl for the purpose of maintaining each position of the ratchet wheel upon de-actuation of the cylinder 53.

FIGS. 5, 6, and 7 may be taken together, to illustrate essentially the operation of the reciprocating punch 29, and the method of transmitting a discharged terminal 30 to the proper position for insertion by the machine 10. In particular, FIG. 5 illustrates the die 29 in a pre-

actuated position with an encapsulated terminal 30 poised above the channel 52. Connected to the plate 49 and fixed below the lower opening of the channel 52 is a guide block 67 which contains a bore extending completely therethrough, which acts like a funnel, owing to its sloping side portion 68; although it does not have a round cross-section because that might permit the terminals 30 to turn upside down as they fell through it. Instead, the sides of this passageway through the guide block 67 are generally flat. It may be observed that the die 29 has at its lower end a pointed portion 69, the slope of which is parallel to the slope 68 and the tip of which is on the far side of the channel 52 from the side 68. The pointed portion 69 cooperates with the side 68 to orient the terminal 30 properly for the insertion position. Pivotaly connected to the block 67 is a support lever 71 having a laterally extending support portion 72 which is adapted to be moved back and forth with respect to the block 67 through an orifice 73 which opens into the bore 65. In FIG. 6 the portion 72 is shown to have intercepted the path of a terminal 37 for the purpose of retaining the terminal in the position shown. It should be noted that the arm 71 is normally resiliently biased to the position shown in FIG. 6.

In FIG. 7, a terminal 37 is shown in its insertion position in a machine of the type described and claimed in the co-pending application Ser. No. 14,998 filed Feb. 27, 1970 by the same applicants, although it is important to note that the particular configuration of the insertion machine 10 is arbitrary for purposes of the present invention. It is only required for present purposes that the actuating motion of the insertion machine occur simultaneously with the actuating motion of the present feed device; for example, upon actuation of the components illustrated in FIGS. 5-7, the sleeve 74 will descend until the tip 76 impacts against the workpiece 14, at which time the push-rod 77 inserts the terminal 30 into the hole 78. As the sleeve 74 descends, it may be seen that it carries with it the funnel 79 pivotally connected thereto. Referring now to FIG. 5, it may be seen that as the funnel 79 descends with the sleeve 74 away from the block 67, the arm 71 will react to its bias and penetrate into the shaft 65. Descending simultaneously with the sleeve 74 and the funnel 79 is the punch 29, and it may be seen that it will perforate the pocket 31 to release terminal 30 which subsequently falls into the shaft 65 until it reaches the position illustrated in FIG. 6. As has been mentioned above, the depending sloped portion 69 of the punch 29 cooperates with the sloped side 68 of the shaft 65 to determine the orientation with which the terminal 30 will descend to the support portion 72. It should be noted that terminal 30a will have been inserted into the workpiece 14 while a later terminal 30 is being released from its pocket 31. Upon completion of the insertion process, the double-acting pneumatic cylinder 13 (shown in FIG. 1) will retract the sleeve 74 and its tip 76 to the position illustrated in FIG. 7, while the funnel 79 will have been returned to the position illustrated in FIG. 5. The funnel 79 may be provided with a raised portion 81 which has the effect of carrying the arm 71 and its support portion 72 away from the block 67 to retract the support portion 72 from the shaft 65, the effect of which is to release terminal 30 which may then

fall through the funnel 79 into the position illustrated by terminal 30a in FIG. 7.

It is important to note that pneumatic cylinders 13 and 53 are coordinated such that the retraction stroke of the cylinder 13 is simultaneous with the actuation stroke of the cylinder 53, the effect of which is to cause the supply tape 22 to be moved one incremental step while the punch 29 is being retracted, so that another encapsulated terminal may be positioned over the channel 52, poised for release during the next successive stroke of the punch 29.

For the purpose of ensuring an efficient perforation of the pocket 31 by the die 29, the present device may be provided with a pair of pressure fingers 82 and 83 which will compress the side portions of the tape 22 between themselves and the plate 49 upon actuation of the device. One way to ensure that sufficient pressure is applied is to provide a pair of pressure plungers 84 and 86 which are slidably mounted in a pair of guide blocks 87 and 88. Actuation of the plungers 84 and 86 may be accomplished by fixing them to an actuator plate 89 having a pin 91 which engages the slot 66 in the punch 29. It may be seen, therefore, that the downward stroke of the punch 29 will cause the upper end of the slot 66 to intercept the pin 91 thereby to carry the latter and its plate 89 and plungers 84 and 86 downward until completion of the perforation process. Springs 92 and 93 may be connected between the guide block 88 and the plate 89 for the purpose of ensuring a quick retraction of the plungers 84 and 86, so that the pressure through the fingers 82 and 83 against the tape may be relieved sufficiently early so as not to interfere with the transport of the tape upon retraction of the punch 29.

What is claimed is:

1. Means for separating each of a series of elongated, generally cylindrical components from a flexible strip of material in which they are individually packaged at equal intervals, said means comprising:

- A. A support member having an opening slightly wider and slightly longer than said components;
- B. Means for moving said strip across said support member in increments equal to the distance from one of said components to the next to align each of said components with said opening;
- C. A punch aligned with said opening and cyclically movable to push each of said components away from said strip and into said opening, said punch being connected to said means for moving said strip to operate synchronously therewith;
- D. Vertical walls communicating with said opening to form a vertical channel;
- E. A sloping wall in said channel below said opening, the direction of slope of said sloping wall being such that one end of a component falling through said channel with the axis of the component horizontal would strike said sloping wall before the remainder of said component, the lower end of said sloping wall and adjacent portions of said vertical walls forming a second opening having dimensions sufficiently large to allow said component to fall through with its axis vertical but not horizontal; and
- F. Means to allow one of said components at a time to pass through said second opening, said last-named means being connected to said means for

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moving said strip to operate synchronously therewith.

2. The apparatus of claim 1 in which said punch comprises a depending portion extending from the lower end thereof on the opposite side from said sloping wall to cooperate with said sloping wall to tilt each of said components in a predetermined direction in passing through said channel.

3. The apparatus of claim 1 in which said means for moving said strip comprises:

- A. A drive cylinder, said strip engaging said drive cylinder to be moved thereby;
- B. A take-up cylinder, said strip being wound up on said take-up cylinder after moving past said drive cylinder;
- C. A pneumatic cylinder;
- D. A pawl connected to said pneumatic cylinder to

be operated thereby; and

E. A ratchet actuated by said pawl and non-rotatably connected to said drive cylinder to rotate said drive cylinder a predetermined amount each time said pneumatic cylinder operates said pawl to move said strip a predetermined amount.

4. The apparatus of claim 3 comprising, in addition:

- A. Sprockets on said drive cylinder; and
- B. Sprocket holes in said strip.

5. The apparatus of claim 1 in which each of said components is enclosed in said strip with its axis perpendicular to the direction of movement of said strip, and said opening in said support member has its longer dimension perpendicular to the direction of movement of said strip.

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