United States Patent

Kindell et al.

[15] **3,673,665**

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[54] STAKING MACHINE

[72] Inventors: **Colin David Kindell,** 22 Forest Walk, Bushey; **Terence Robert Raynor,** 15 Russell Road, London, both of England

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**29/203 D,** 29/203 R

[51] **Int. Cl.** **H01r 43/04**

[58] **Field of Search** .....29/203 D, 203 DT, 203

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Primary Examiner—Thomas H. Eager

Attorney—William J. Keating, Ronald D. Grefe, Gerald K. Kita, Frederick W. Raring, Jay L. Seitchik and John P. Vandenburg

[57] **ABSTRACT**

A machine is disclosed for staking terminal pins to a printed circuit board in which two strips of terminal pins are fed alternately towards a shear anvil along separate paths. The leading terminal pin of each strip is received within one of a pair of spaced channels in a shear anvil positioned adjacent a shear block. The shear anvil is arranged to move between a first position in which one channel is in alignment with a terminal pin feed path while the second channel is in alignment with a staker and a second position in which the one channel is in alignment with the staker and the second channel is in alignment with a terminal feed path. Movement of a channel from a position in alignment with a feed path to a position in alignment with the staker causes a terminal pin in the channel to be sheared from the strip.

5 Claims, 6 Drawing Figures

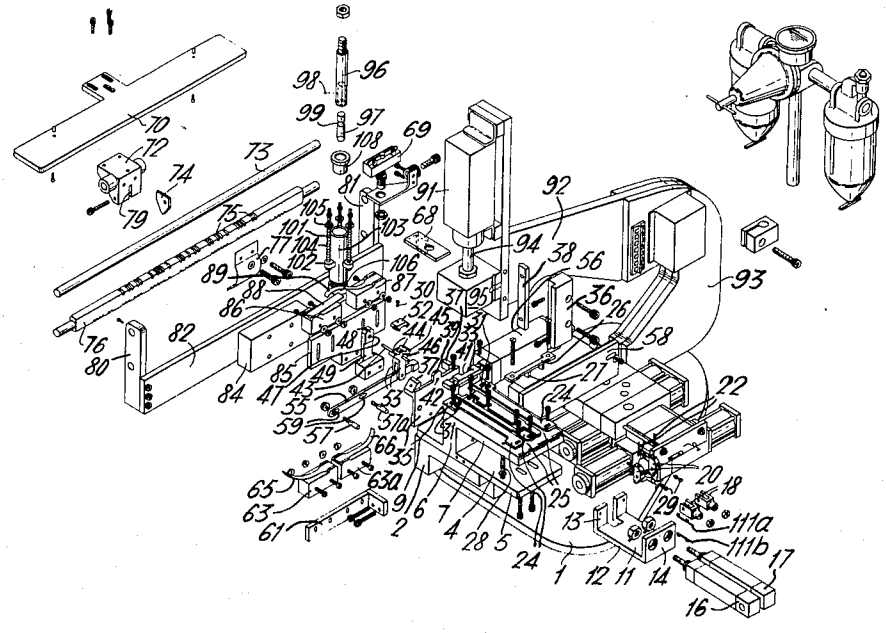


Fig. 1.

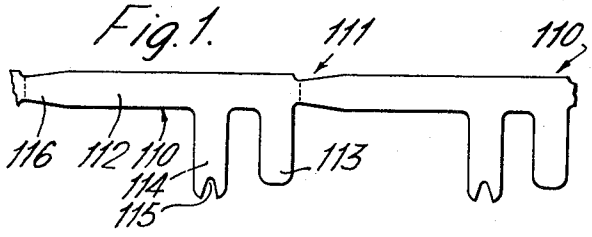


Fig. 4.

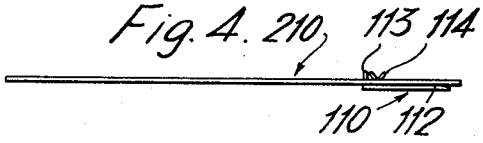


Fig. 5.

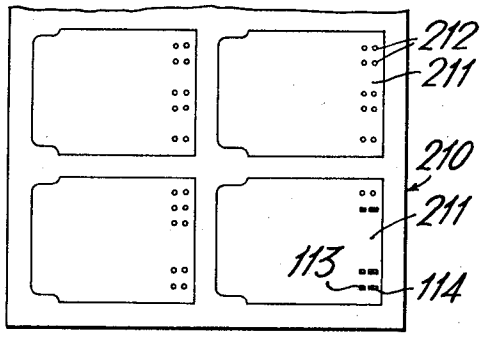
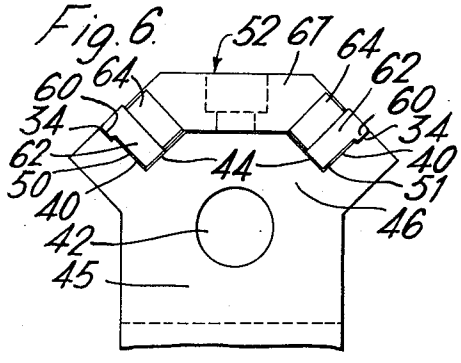


Fig. 6.



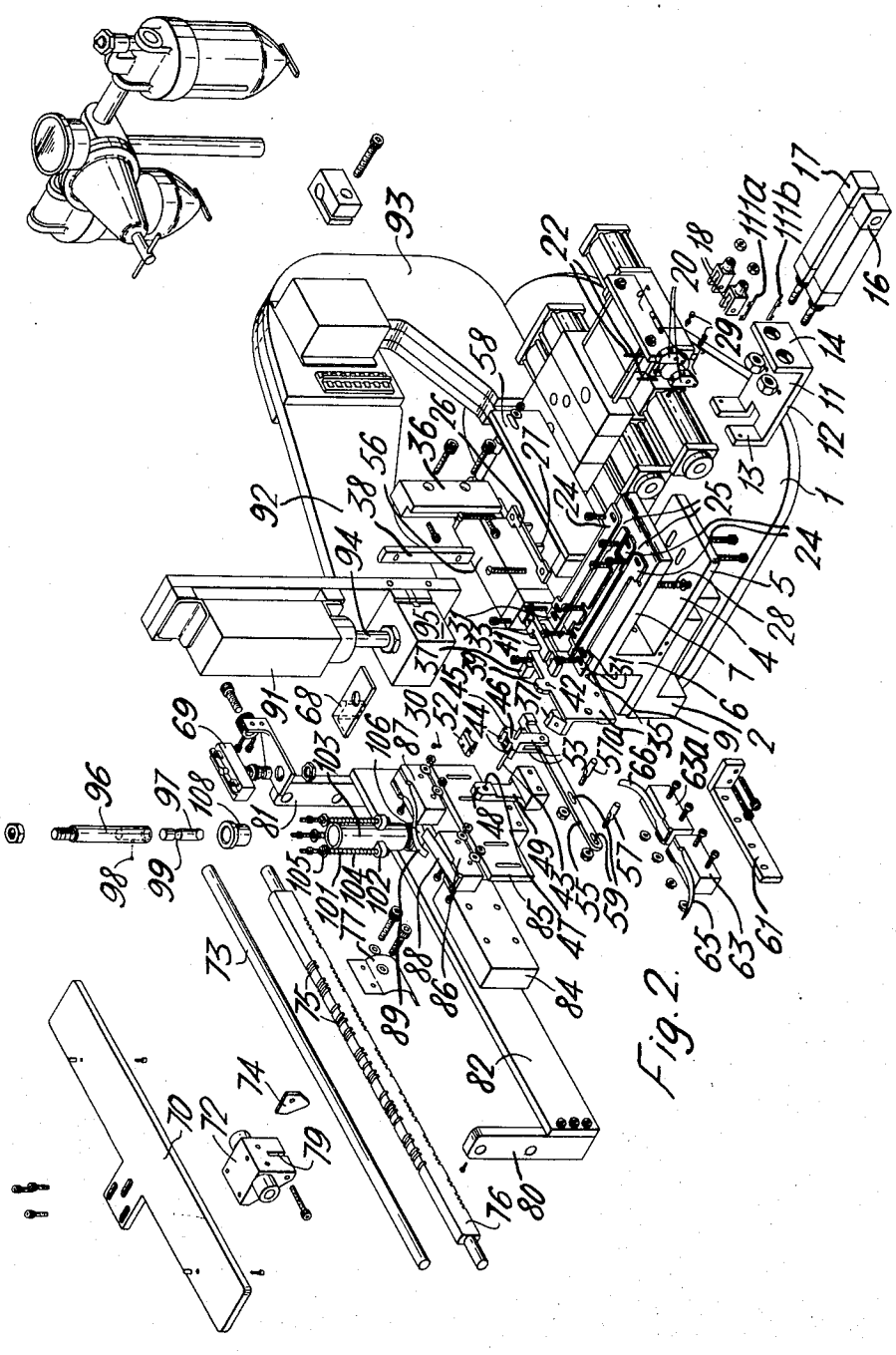


Fig. 2.

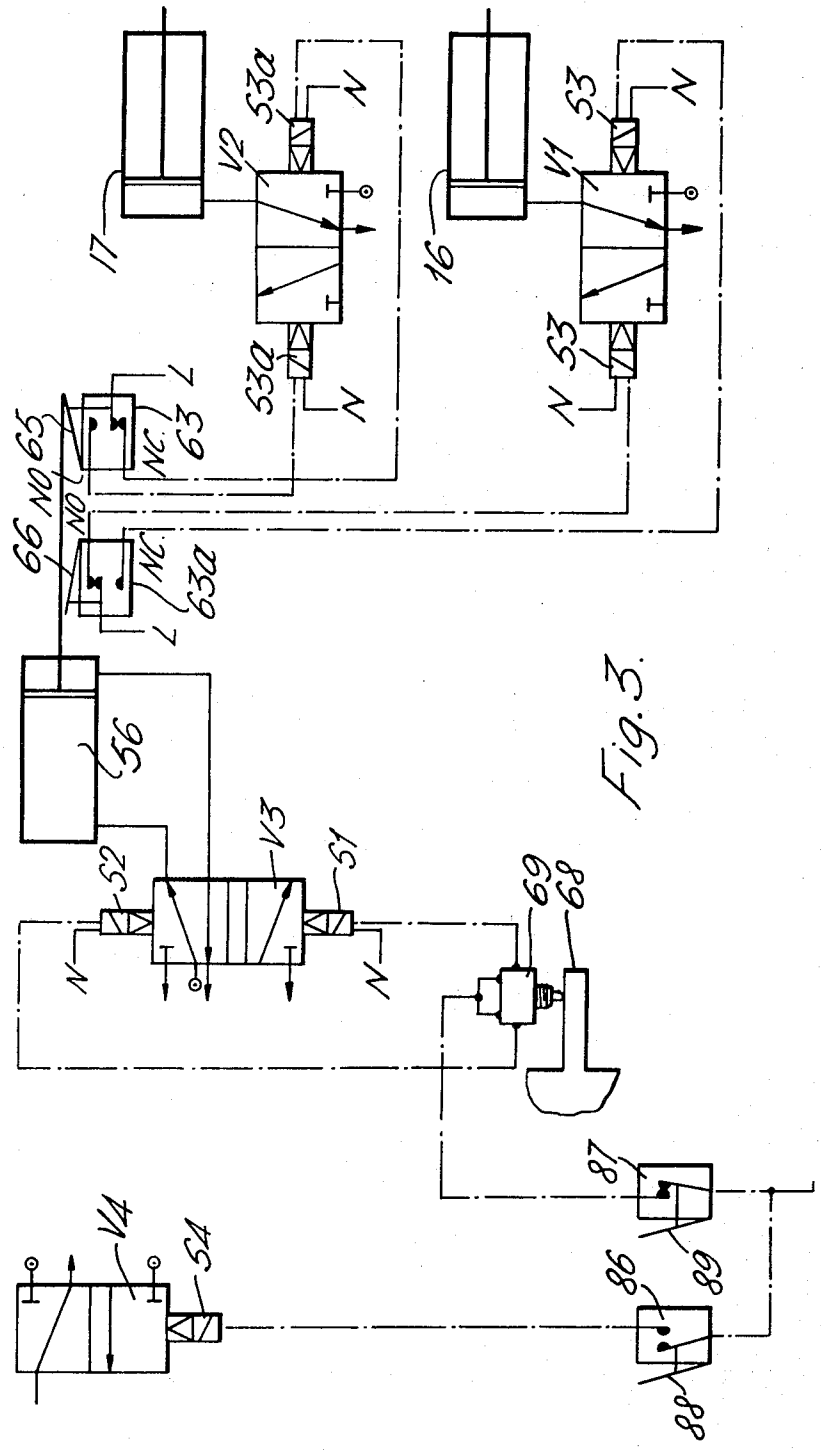

17
16
V2
V1
53a
53
N
NC
NO
63
63a
65
66
56
V3
V4
51
52
54
68
69
87
86
89
88

Fig. 3.

STAKING MACHINE

This invention relates to apparatus for staking electrical terminals to printed circuit and like boards.

According to the invention, apparatus for staking individual electrical terminals from a strip of such terminals to a board, comprises a staker movable towards and away from an anvil having a holder for a leading terminal, feed means for feeding the strip along a feed path past a shear block to the terminal holder, the anvil being adjacent the shear block and movable to move the holder laterally of the shear block between a first position in alignment with the feed path and a second position in alignment with the staker, movement of the holder in one direction between the positions being arranged to shear a leading terminal from the strip and in the other direction to advance the staker towards the anvil.

The terminal holder preferably comprises a channel defined by a surface of a groove formed in the anvil and a co-operating surface part of an associated guide block. Advantageously, the co-operating surface part of the guide block is resiliently attached to a body part of the guide block. The resilient mounting enables a terminal to be held firmly in the holder and minimizes relative movement between the terminal and the anvil when the anvil is between the first and second positions.

Preferably the feed means are arranged to feed two strips of terminals alternately to the anvil along separate paths, the leading terminal of each strip being receivable within a corresponding one of two holders arranged such that as one holder is aligned with its corresponding feed path, the other is in alignment with the staker.

The apparatus preferably includes for a support board having a member to be staked, a locating device remote from the staker and anvil and comprising an elongate locating comb having longitudinally spaced circumferential grooves. A baseplate for the board is mounted adjacent the locating comb for movement about and parallel with the locating comb and has a pivotal finger receivable within a groove in the locating comb.

An embodiment of the invention is described by way of example with reference to the accompanying drawings, in which:

FIG. **1** is a plan view of part of a strip of terminals;

FIG. **2** is an exploded perspective view of apparatus for staking the terminals of FIG. **1** to a support board;

FIG. **3** is a circuit diagram of the apparatus of FIG. **2**;

FIG. **4** is a side view of a board to which a terminal has been staked;

FIG. **5** is a partial plan view of the board of FIG. **4**; and

FIG. **6** is a detail of an anvil and a guide block forming part of the apparatus of FIG. **2**.

A terminal pin **110** of FIG. **1** is formed of electrically conductive material, for example, brass or steel, in the configuration of a strip **111**. Each pin **110** includes an elongate body part **112** and two arms **113,114** extending from one side adjacent the leading end of the pin. The free end of the arm **114** is notched at **115**. A portion **116** of the body part **112** tapers towards the trailing end of the pin.

A support board **210**, FIGS. **4** and **5**, has two rows of printed circuit modules **211**, each having pairs of holes **212** for receiving the arms **113,114** of a terminal pin **110** by a staking operation. After staking the pins are flow soldered to the board and the individual modules **211** are pushed out of the support board **210** leaving the pin body parts **112** extending beyond the edge of the modules for electrical connection to, for example, wire terminals.

As shown in FIG. **2**, an electro-pneumatic apparatus for staking terminal pins **110** to a module **211** includes a baseplate **1** to which is fixed a mounting block **2**. Attached to the mounting block **2** is a generally C-shaped member **4** comprising a lower plate **5**, an upright wall **6** and an upper plate **7**. The plate **7** has two longitudinally extending spaced parallel slots (not shown), each accommodating a feed finger **22**. Mounted on the plate **5** is a terminal pin feed assembly support **11** having a base part **12** and two side walls **13,14**. The wall **14** supports two pneumatic piston and cylinder units **16,17**, each connected to a clevis **18** to which is pivotally attached a feed finger holder **20** for one of the feed fingers **22**. Pivotal movement of the feed finger holders **20** is controlled by adjusting screws **29**.

Guides **24** extend laterally of the slots in the plate **7**. The guides are each recessed along an edge adjacent a corresponding slot to define with the upper surface of the plate **7** channels **25** for receiving strips **111***a*,**111***b* of terminal pins **110**. A drag plate **26** is biased by springs **28** (only one shown) downwardly towards the guides **24**. The drag plate **26** has legs **27** which extend into the channels **25**. The ends **31** of the guides **24** overhang the end **9** of the plate **7** and are stepped to receive a shear block **33**. An edge of the shear block **33** co-operates with a shear anvil **45**, as explained below.

A space plate **35** attached to the wall **6** has bosses **37** having adjustable stop screws (not shown) for limiting the movement of the shear anvil **45**. The space plate **35** has a projection **39** which extends into a recess **41** in the shear block **33** and a hole **42** for receiving an end of a pin **43** on which is pivotally secured the shear anvil **45**. The opposite end of pin **43** is received in a hole **47** in a head **48** of an anvil holder **49**. The shear anvil **45** has a body part **46** and two depending legs **53**. The body part **46** is of generally U-shaped configuration and has two V-sectioned grooves **44** extending across one surface, (the upper as seen in FIG. **2**). As best seen in FIG. **6**, the surfaces **40** of the grooves **44** subtend an angle of substantially 90° at the center of the hole **42**. A recess **34** is formed at the upper end of each surface **40** and receives a raised portion **60** of a shoulder member **62** of a guide block **52**. The shoulder members **62** are adhered to resilient blocks **64**, for example, of rubber, which are also adhered to a central body part **67** of the guide block **52**. The opposed surface of the shoulder members **62** and the surfaces **40** define terminal pin-receiving slots **50,51**. The guide block **52** is secured to the body part **46** by a screw **30**.

The legs **53** of the shear anvil **45** pivotally straddle a lever **55** secured to a piston and cylinder unit **56**. The lever **55** has spaced slots **59** through which extend pins **57,57***a*. The unit **56** is mounted on a bracket **58** secured to the wall **6** of the member **4**. An L-shape bracket **61** is mounted on the member **4** and supports micro-switches **63**, **63***a* having switch arms **65,66** for engaging the pins **57**, **57***a* on the lever **55**.

A board support plate **70** is secured to a block **72** rotatably and slidably mounted on a shaft **73**. The block **72** has a recess **79** in which is mounted a finger **74** for engaging one of circumferential grooves **75** on a locating comb **76**, the grooves **75** being spaced according to the center pitch distance between staking holes **212**. A spring **77** attached to the block **72** biases the plate **70** away from the comb **76**. The shaft **73** and comb **76** are mounted between end arms **80,81** of a member **82** secured to the base plate **1**. The member **82** is secured to a space block **84** on which is a bracket **85** for supporting micro-switches **86,87** having switch arms **88,89** respectively.

A pneumatic piston and cylinder unit **91** is mounted on an arm **92** of a generally C-shaped bracket **93** welded to the base plate **1**. Attached to an actuating rod **94** extending from the unit **91** is a block **95** to which is secured a tubular staker mounting member **96**. A staker **97** is releasably secured to the member **96** by pins **98** (only one shown) received in through holes (not shown) in the member and engaging within a groove **99** in the staker. Three rods **101** are each secured at one end to the block **95** and at the opposite end to lugs **102**. Each rod **101** has a spring **104** biased between the lug **102** and a washer **105**. A rubber pad **106** is attached to the end of the tubular member **103** remote from the block **95**. A bushing **108** fits within the upper end of the tubular member **103** and the member **96** is a sliding fit within the bore of the bushing **108**.

Two guide members **38** (only one shown) extend alongside the block **95** and are each secured to a block **36** attached to the side of the arm **92**. A striker plate **68** is attached to the block **95** and has a depending arm for actuating a change-over switch **69**.

Referring to the circuit diagram of FIG. 3, when the support plate **70** is pivoted to engage arms **88,89** of micro-switches **86,87** the contacts of micro-switch **86** are closed and current is supplied to a solenoid S4 to actuate valve V4 which controls the air supply to a foot pedal (not shown) for activating unit **91**. At the same time, the contacts of micro-switch **87** are opened to break the circuit to the change-over switch **69** which controls the current flow to either of two solenoids S1,S2 which control a double solenoid operated valve V3 supplying air to either side of the piston in unit **56**.

Movement of the piston of unit **56** via lever **55** and pins **57,57*a*** operates one of the two micro-switches **63,63*a*** which control solenoids S3,S3*a* on valves V1,V2 respectively. Valve V1 controls the operation of unit **17**.

Two strips **111*a*,111*b*** of terminal pins **110** are fed from reels (not shown) into the channels **25** where they are engaged by the feed fingers **22**. Electrical and pneumatic supplies to the apparatus are then switched on. A support board **210** is rested on the support plate **70** which is moved along shaft **73** until the finger **74** is positioned above a preselected groove **75** in the locating comb **76**. The support plate **70** is then pivoted against the bias of spring **77** to locate finger **74** in the groove to locate the support board **210** accurately with respect to the staker **97** and shear anvil **45**.

When the unit **91** is fully retracted, the staker **97** is remote from the shear anvil **45** and channel **50** contains a terminal pin **110** in alignment with the staker, and the channel **51** is aligned with the channel **25** containing the strip **111*a***, and unit **56** is extended. The support plate **70** is pivoted further against the spring **77** to locate the arms **113,114** of the terminal pin **110** in the holes **212** in the support board **210**.

Pivotal movement of the plate **70** also engages arms **88,89** of micro-switches **86,87** respectively. Engagement of arm **88** actuates the solenoid S4 on the valve V4 controlling the supply of air to the unit **91** via the foot pedal, and an indicator light (not shown) to show the operator that the support board **210** is correctly positioned.

A foot pedal (not shown) is depressed to actuate unit **91** through one forward and return stroke. On descent of the block **95**, the rubber pad **106** engages the upper surface of the support board **210** to ensure full engagement of the arms **113,114** in the board to hold the board in position during staking. The downward movement of the tubular member **103** then ceases, but the member **96** and staker **97** continue to descent against the springs **104** until the staker **97** engages the notch **115** in the arm **114** of the terminal pin **110** to stake the pin **110** to the board **210**.

While the channel **51** is aligned with the channel **25** containing the strip **111*a***, pin **57** engages the arm **65** of the micro-switch **63** controlling the flow of air to the unit **17** via the valve V2. Air is thus supplied to the unit **17** to feed the leading terminal pin **110** of strip **11*a*** into the channel **51**. At the same time unit **16** is allowed to retract.

After staking, the unit **91** completes its return stroke and block **95** ascends and striker plate **68** actuates the change-over switch **69**. The retraction of the unit **91** permits the support board **210** to be moved for the next staking. Pivotal movement of the support plate **70** away from the locating comb **76** during re-location of the support board **210** disengages the plate **70** from the arms **88,89** which breaks the contacts in the micro-switch **87** to activate the change-over switch **69** to operate valve V3 to cause the unit **56** to retract.

Retraction of the unit **56** causes the lever **55** to move to the right (as shown in FIG. 2), which pivots the shear anvil **45** in an anti-clockwise sense about the pin **43** and shears the terminal pin **110** in the channel **51** from terminal pin strip **111*a*** by movement of the shear anvil **45** against the lower face of the shear block **33**. The channel **51** with the terminal pin **110** from the strip **111*a*** is thus aligned with the staker **97** while the channel **50** is aligned with the channel **25** containing the strip **111*b***.

Pin **57*a*** will then engage arm **66** of micro-switch **63*a*** which controls via valve V1 the flow of air to unit **16** to feed the leading terminal **110** of strip **111*b*** into the channel **50**.

Since the valve V4 is de-activated on removal of the board **210** from the staking position inadvertent actuation of the unit **91** is minimized. Similarly, since the change-over switch **69** is activated only after removal of the board **210** this minimizes the risk of a strip being fed to the shearing anvil **45** while the board **210** is still in the staking position and before the shearing anvil **45** has moved after staking.

We claim:

1. Apparatus for staking individual electrical terminals from a strip of such terminals to a board, comprising a staker movable towards and away from an anvil having a holder for a leading terminal, feed means for feeding the strip along a feed path past a shear block to the terminal holder, the anvil being adjacent the shear block and movable to move the holder laterally of the shear block between a first position in alignment with the feed path and a second position in alignment with the staker, movement of the holder in one direction between the positions being arranged to shear a leading terminal from the strip and in the other direction to advance the staker towards the anvil.

2. Apparatus according to claim **1**, in which the terminal holder comprises a channel defined by a surface of a groove formed in the anvil and a co-operating part of an associated guide block.

3. Apparatus according to claim **1** in which the feed means are arranged to feed two strips of terminals alternately to the anvil along separate paths, the leading terminal of each strip being receivable within a corresponding one of two terminal holders arranged such that as one holder is aligned with its corresponding feed path, the other is in alignment with the staker.

4. Apparatus according to claim **1** including a locating device remote from the staker and anvil for a support board having the members to be staked.

5. Apparatus according to claim **4**, in which the locating device comprises an elongate locating comb having longitudinally spaced circumferential grooves, a baseplate for the board about and parallel with the locating comb and having a pivotal finger receivable within a groove in the locating comb.

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