Aug. 29, 1961 R. D. RUNCIMAN 2,998,289

FEED MECHANISMS

Filed Dec. 1, 1959 2 Sheets-Sheet 1

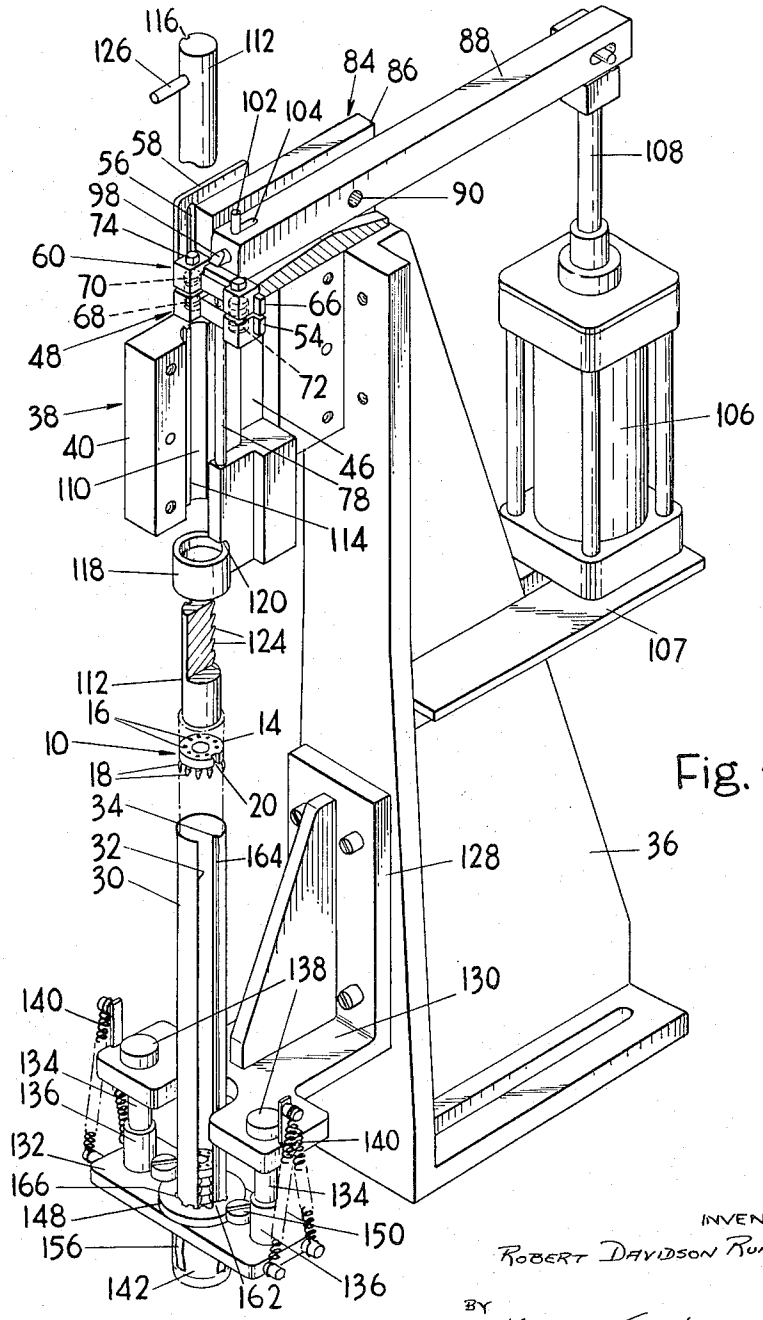

Fig. 1

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Fig. 2

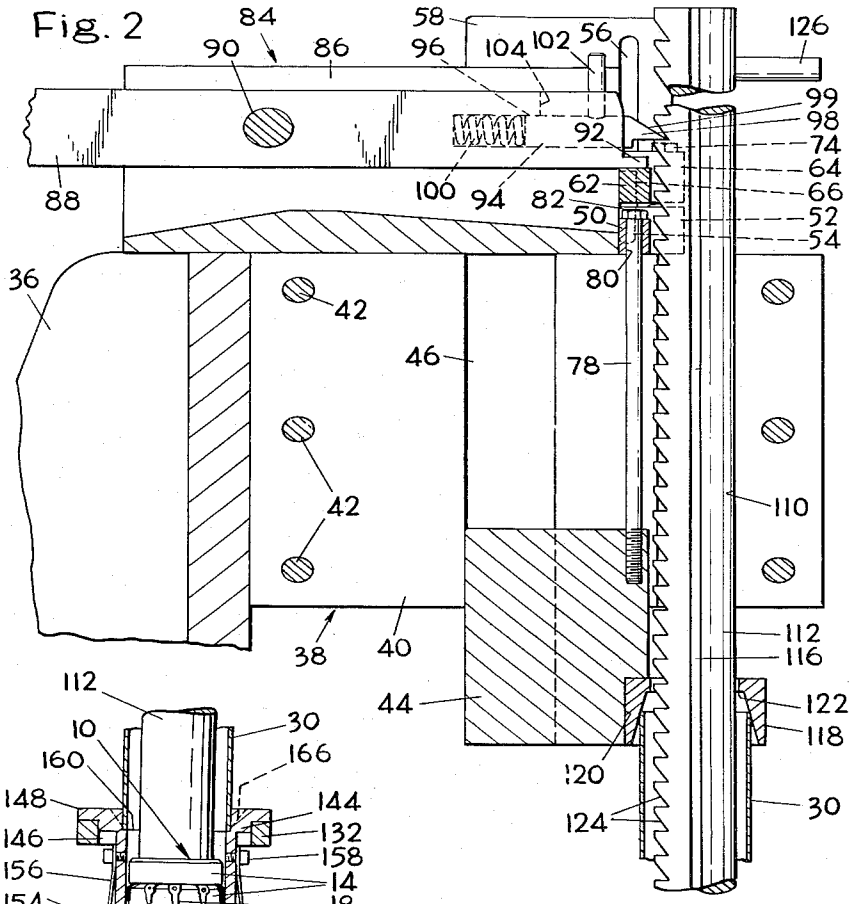

Fig. 3

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United States Patent Office 2,998,289 Patented Aug. 29, 1961

2,998,289

FEED MECHANISMS

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Filed Dec. 1, 1959, Ser. No. 856,601
Claims priority, application Great Britain Dec. 4, 1958
3 Claims. (Cl. 312—71)

This invention relates to feed mechanisms.

According to the invention, a feed mechanism includes a container which is elongated and is open at both ends, the container being adapted to contain a plurality of similar articles abutting against one another in an orderly succession extending along the length of the container, a ram which is arranged to bear against an end one of the succession of articles, and a reciprocable member which in operation has a substantially constant length of stroke and which is coupled to the ram by a linkage at least partly constituted by a ratchet and pawl mechanism, the arrangement being such that during each forward stroke of the reciprocable member the articles in the container are pushed lengthwise through the container by the ram over a distance substantially equal to the spacing of the articles in the container.

One arrangement in accordance with the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view, shown partly broken away, of a mechanism for mounting valve holders on printed circuit panels;

FIGURE 2 is an enlarged central sectional elevation of the upper part of the mechanism; and

FIGURE 3 is an enlarged central sectional elevation of the lower part of the mechanism.

The mounting mechanism is designed to form one of a number of component insertion heads of an in-line assembly machine such as is described in United States Patent No. 2,890,456. The in-line assembly machine includes a track along which are pushed a number of printed circuit panels each mounted on, and located in a fixed position with respect to, a supporting platen, and the component insertion heads are mounted at intervals along the length of the track. The platens are arranged to be moved along the track intermittently so that they are positioned in sequence beneath the series of component insertion heads, the platens being located accurately in position while the heads operate to mount electrical components on the panels supported by the platens.

Referring to the drawings, the mechanism is adapted to mount valve holders **10** on to printed circuit panels such as the panel **12** (see FIGURE 3). Each valve holder **10** includes a substantially circular cylindrical ceramic block **14**, the block **14** having a diameter of about 0.7 inch and a thickness of about 0.2 inch. A number of valve pin sockets **16** are formed in the block **14**, and a corresponding number of similar metal tags **18** are respectively formed integral with the sockets **16**. The tags **18** are disposed at intervals around the block **14**, and are bent so that the end portions of the tags **18** project perpendicularly from one end face of the block **14**, the end portions of the tags **18** being disposed slightly beyond the periphery of the block **14**; the arrangement is such that a number of the holders **10** can be arranged in an orderly succession abutting against one another with the tags **18** of one holder **10** fitting around the block **14** of the next holder **10** as is clearly shown in FIGURE 3. The block **14** of each holder **10** has a groove **20** formed in its curved surface, the groove **20** extending perpendicularly to the end faces of the block **14**.

The panel **12** is mounted on an anvil plate **22** which is in turn mounted on a supporting platen **24**. The panel

12 has formed in it a number of small holes **26** into which the tags **18** of a holder **10** are intended to be inserted, and a number of concave grooves **28** are formed in the upper face of the anvil plate **22**, the grooves **28** corresponding in position with the holes **26**; the arrangement is such that, with the panel **12** located in position on the platen **24**, when the tags **18** of a holder **10** are inserted into the holes **26**, the ends of the tags **18** strike the curved surfaces of the grooves **28** and are thereby bent over outwardly against the underside of the panel **12** so as to fix the holder **10** securely in position relative to the panel **12**.

The mechanism includes an elongated tubular metal magazine **30** having a circular cross-section except for a longitudinal slot **32** formed in the wall of the magazine **30**, and a longitudinal ridge **34**, formed adjacent one of the bounding edges of the slot **32**, projecting into the interior of the magazine **30**. When fully loaded, the magazine **30** contains a stack of about fifty valve holders **10** arranged as described above with the ridge **34** fitting into the grooves **20** of the holders **10**; thus, it will be appreciated that the ridge **34** and the grooves **20** provide a means for ensuring that the holders **10** contained in the magazine **30** are all arranged in the same angular position relative to the magazine **30**.

The mechanism also includes a vertically extending support **36** which is adjustably secured to the base (not shown) of the in-line assembly machine. A fixed block **38** is secured to the upper end of the support **36**, the block **38** being formed in to complementary parts **40** (only one of which is shown in FIGURE 1) which are secured together by means of bolts **42**. A slide block **44** of T-shaped cross-section is slidably mounted in the fixed block **38**, the block **44** being a sliding fit in a vertically extending recess **46**, having a cross-section corresponding to that of the block **44**, which is formed in the block **38**.

A slidable member **48** is disposed above the fixed block **38**, the member **48** comprising a bar **50** the ends of which are formed integral with two blocks **52**. The outer face of each block **52** has a projection **54** formed on it, and the projection **54** are respectively in sliding engagement with two vertically extending slots **56** formed in two parallel vertical plates **58** (only one of which is shown in FIGURE 1) projecting upwards from the upper edges of the fixed block **38**. A second slidable member **60**, similar in shape to the member **48**, is disposed above the member **48**; the slidable member **60** also comprises a bar **62** the ends of which are formed integral with two blocks **64**, and two projections **66** are formed on the outer faces of the blocks **64**, the projections **66** also being in sliding engagement with the slots **56**.

Two circular recesses **68** are respectively formed in the upper faces of the blocks **52**, and two further recesses **70** are respectively formed in the lower faces of the blocks **64**. The members **48** and **60** are urged apart by means of two compressed springs **72**, the lower parts of the springs **72** being accommodated in the recesses **68** and the upper parts of the springs **72** being accommodated in the recesses **70** so that the ends of each spring **72** respectively bear against the bases of the relevant pair of recesses **68** and **70**. Movement apart of the members **48** and **60** is limited by means of two bolts **74** which are slidably mounted with respect to the blocks **64**; the shanks of the bolts **74** extend inside the springs **72** with the ends of the bolts **74** screwed into the blocks **52**, while the heads of the bolts **74** normally bear against the upper faces of the blocks **64** thereby determining the furthest distance apart of the members **48** and **60**. It should be appreciated that the combination of the slidable members **48** and **60** is movable in a vertical direction with respect to the fixed block **38** with the projections **54** and **66** sliding inside the slots **56**.

The slide block 44 is connected to the member 48 by means of a vertically extending elongated bolt 78 the lower end of which is screwed into the upper end of the block 44. The shank of the bolt 78 passes through, and is a sliding fit with respect to, a hole 80 formed in the bar 50, and the head 82 of the bolt 78 is disposed between the bars 50 and 62 thereby limiting the relative movement in a vertical direction between the slide block 44 and the member 48.

A channel member 84 of U-shaped cross-section is secured to the upper end of the fixed block 38, the channel member 84 extending horizontally between the support 36 and the two slidable members 48 and 60 with parts of the sides 86 (only one of which is shown in FIGURE 1) of the member 84 being disposed between the plates 58. Part of a lever 88 is disposed inside, and extends along the length of, the channel member 84, the lever 88 being pivoted about a spindle 90 the ends of which are respectively secured to the sides 86. A tongue 92 is formed integral with the lower part of that end of the lever 88 adjacent the members 48 and 60, the tongue 92 being disposed immediately above the bar 62.

A rod 94 is slidably housed in a horizontally extending recess 96 formed in that end of the lever 88 adjacent the members 48 and 60, and a pawl 98 provided with a chamfered upper surface 99 is formed integral with one end of the rod 94, the pawl 98 projecting beyond the end of the lever 88. A helical spring 100 is compressed between the closed end of the recess 96 and that end of the rod 94 remote from the pawl 98, and an upwardly projecting arm 102 is secured to the rod 94, the arm 102 passing through a slot 104 in the lever 88 and projecting above the sides 86 of the member 84; the arm 102 and slot 104 serve to locate the rod 94 and the pawl 98 in a fixed angular position with respect to the lever 88.

A vertically extending double-acting air cylinder 106 is mounted on a platform 107 secured to the support 36, and a piston rod 108 is attached to a piston (not seen) associated with the cylinder 106, the piston rod 108 extending in a vertical direction from the upper end of the cylinder 106. The upper end of the piston rod 108 is pivotally linked to that end of the lever 88 remote from the pawl 98 so that the lever 88 is pivoted about the spindle 90 upon movement of the piston rod 108.

A vertically extending hole 110 is formed in the block 38, the hole 110 being of substantially circular cross-section and communicating with the narrow part of the recess 46. A vertically extending rod 112 is disposed partly inside, and is a sliding fit with respect to, the hole 110, the rod 112 being located in a fixed angular position with respect to the block 38 by virtue of a longitudinal ridge 114 formed in the bounding wall of the hole 110 engaging in a longitudinal groove 116 formed in the rod 112. The rod 112 also passes through, and is a sliding fit with respect to, a bush 118 which is secured to the lower part of the narrow portion of the slide block 44, part of the wall of the bush 118 being located in a recess 120 formed in this portion of the block 44. The bore of the bush 118 tapers inwardly from the lower end of the bush 118, the tapered portion being terminated at its upper end by means of a circumferential shoulder 122; the mean diameter of the tapered part of the bore of the bush 118 is equal to the outer diameter of the magazine 30.

A series of teeth 124 are formed on the rod 112, the series of teeth 124 extending longitudinally for most of the length of the rod 112 and facing the support 36. The spacing of the teeth 124 is equal to the spacing of the valve holders 10 when housed in the magazine 30, and the arrangement is such that the pawl 98 is normally held in resilient engagement with the rod 112 immediately above one of the teeth 124 by means of the spring 100. It should be appreciated that the pawl 98 and the teeth 124 constitute a ratchet and pawl mechanism connecting the rod 112 to the adjacent end of the lever 88. An arm 126 is secured to the upper end of the rod 112.

A bracket 128 is secured to the lower part of the support 36, the bracket 128 incorporating a horizontal support plate 130. A rectangular movable plate 132 is disposed beneath the support plate 130, and two vertically extending rods 134 are secured to the movable plate 132, the rods 134 projecting upwardly from the plate 132 and passing through, and being a sliding fit with respect to, two holes (not seen) formed in the support plate 130. Two bushes 136 are respectively secured around those parts of the rods 134 adjacent the plate 132, while two circumferential flanges 138 are formed integral with the upper ends of the rods 134. The movable plate 132 is capable of being moved in a vertical direction relative to the support plate 130, and the plate 132 is urged towards the plate 130 by means of four tensioned springs 140 being respectively secured to the plates 130 and 132; it should be understood that upward movement of the plate 132 relative to the plate 130 is limited by virtue of the upper ends of the bushes 136 coming into contact with the lower face of the plate 130, and that downward movement of the plate 132 relative to the plate 130 is limited by virtue of the flanges 138 coming into contact with the upper face of the plate 130.

A bush 142 projects beneath the movable plate 132, the upper end of the bush 142 being formed as a wider portion 144 part of which is a rotatable fit within a circular hole 146 centrally formed in the plate 132. The upper end of the portion 144 is provided wtih a circumferential flange 148 which bears against the upper face of the plate 132, and the bush 142 is normally held in a fixed angular position with respect to the plate 132 by means of two bolts 150, the flange 148 being trapped between the heads of the bolts 150 and the upper face of the plate 132.

Four small steel balls 152 are respectively mounted in four recesses 154 formed in the wall of the bush 142, the centres of the balls 152 lying in a horizontal plane spaced from the lower end of the bush 142 by a distance approximately equal to the thickness of the block 14 of a valve holder 10. The recesses 154 are so shaped that each ball 152 is capable of a limited radial movement with respect to the bush 142. Normally, the balls 152 project partly inside the bush 142, and the balls 152 are urged into this position by means of four generally vertically extending leaf springs 156, the upper ends of which are secured to the bush 142 by means of screws 158 and the lower ends of which respectively bear against the outermost parts of the balls 152; each ball 152 is constrained by the bounding wall of the relevant recess 154 so as to prevent the ball 152 being forced by the relevant spring 156 wholly into the interior of the bush 142.

The magazine 30 is mounted in the mechanism with its axis vertical and with the tags 18 of the valve holders 10 mounted in the magazine 30 pointing downwardly. The lower end of the magazine 30 fits into the upper portion 144 of the bush 142, this end of the magazine 30 abutting against a circumferential shoulder 160 formed in the inner surface of the bush 142; the diameter of the bore of the bush 142 below the shoulder 160 is equal to the internal diameter of the magazine 30, while the diameter of that part of the bore of the bush 142 above the shoulder 160 is equal to the outer diameter of the magazine 30. The magazine 30 is located in a fixed angular position with respect to the bush 142 by means of a longitudinally extending ridge 162 formed on the inner surface of the portion 144 of the bush 142, the ridge 162 engaging in a longitudinal groove 164 formed in the outer surface of the magazine 30. When a loaded magazine 30 is inserted into the upper end of the bush 142, the tags 18 of the lowermost component 10 contained in the magazine 30 project below the magazine 30, and, in order to facilitate the insertion of these tags 18 into the bush 142, a number of grooves 166, corresponding in position to the tags 18, are formed in the upper part of

the bush **142** adjacent the bore of the bush **142**, the grooves **166** sloping inwardly and downwardly from the upper surface of the bush **142**. It should be understood that the bush **152** and the magazine **30** together form a container for the holders **10**, and that normally a few holders **10** are housed in the bush **142** while the remainder of the holders **10** are housed in the magazine **30**. In the condition shown in FIGURE 3 the magazine **30** is empty and all the holders **10** contained in the above-mentioned container are housed in the bush **142**.

The upper end of the magazine **30** is housed in the bush **118**, and normally this end of the magazine **30** is caused to bear resiliently against the inner surface of the bush **118** under the action of the springs **140**.

When the magazine **30** is empty, it can be removed from the mechanism and replaced by a loaded magazine **30** as follows. The arm **102** is moved from right to left (with respect to FIGURE 2) so as to disengage the pawl **98** from the teeth **124** of the rod **112**. The rod **112** is then lifted upwardly by means of the arm **126** to a position in which its lower end is above the lower end of the bush **118**, and the movable plate **132** is depressed to its fullest extent, while the slide block **44** is held in its uppermost position, thereby bringing the upper end of the magazine **30** below the lower end of the bush **118**. The empty magazine **30** is now removed and replaced by a loaded magazine **30**. The movable plate **132** is then allowed to return to its uppermost position, the rod **112** is lowered until its lower end abuts against the uppermost valve holder **10** in the magazine **30**, and the arm **102** is released thereby allowing the pawl **98** to return into engagement with the rod **112**.

The operation of the mechanism will now be described. The printed circuit panel **12** is moved into the desired position beneath the bush **142** while the piston rod **108** is in its lowermost position; while the piston rod **108** is in this position, the assembly of the movable plate **132**, the bush **142** and the magazine **30** is in its uppermost position, the slide block **44** and the slidable members **48** and **60** are also in their uppermost positions with the bar **62** resting on the head **82** of the bolt **78**, the lowermost valve holder **10** in the bush **142** rests on top of those parts of the balls **152** projecting inside the bush **142**, the lower end of the rod **112** abuts against the uppermost valve holder **10** in the magazine **30**, and the pawl **98** is in engagement with one of the teeth **124**.

Upon the commencement of the upward stroke of the piston rod **108**, the lever **88** is pivoted in a clockwise direction (with respect to FIGURE 2) so that the pawl **98** forces the rod **112** downwards. The pressure exerted by the leaf springs **156** on the balls **152** is sufficient at this stage to prevent the lowermost valve holder **10** from moving downwardly past the balls **152**, so that downward movement of the rod **112** also brings about a downward movement of the plate **132**, the bush **142** and the magazine **30**; it should be appreciated that, as the magazine **30** moves downwards, the slide block **44** and the slidable members **48** and **60** also move downwards under gravity so that the bush **118** remains in contact with the upper end of the magazine **30**. The downward movement of the assembly of the movable plate **132**, the bush **142** and the magazine **30** continues until the flanges **138** come into contact with the upper face of the plate **130** thereby causing the downward movement of the bush **142** to be arrested; at this stage the arrangement is as shown in FIGURE 3 of the drawings, the lower end of the bush **142** touching the panel **12**. Also, at this stage, the slide block **44** and the slidable members **48** and **60** have reached their lowermost positions as shown in FIGURE 2, the bar **50** of the member **48** resting on top of the fixed block **38** and the head **82** of the bolt **78** resting on top of the bar **50**.

Thereafter, downward movement of the rod **112** continues and the stack of holders **10** moves downwardly relative to the magazine **30** and the bush **142**, the lowermost holder **10** being forced past the balls **152** thereby causing the balls **152** to be moved outwardly against the pressure exerted by the leaf springs **156**. The ends of the tags **18** of the lowermost holder **10** are caused to pass through the holes **26** in the panel **12** and to be bent over outwardly against the underside of the panel **12** by virtue of their being pressed against the grooves **28** formed in the anvil plate **22**; at this stage the piston rod **108** is in its uppermost position and the arrangement is as shown in FIGURE 2. The upper edge of each holder **10** is chamfered as is clearly shown in FIGURE 3 so that at this stage the balls **152** again project into the bush **142**, that holder **10** adjacent the holder **10** is just mounted on the panel **12** bearing downwardly on the balls **152** so as to retain the assembly of the bush **142**, the movable plate **132** and the magazine **30** in its lowermost position. Just prior to the rod **112** reaching its lowermost position, the tongue **92** formed on the lever **88** comes into contact with the bar **62**, and the remainder of the downward movement of the tongue **92** brings about a slight downward movement of the bar **62** against the pressure exerted by the springs **72**.

Upon the commencement of the downward stroke of the piston rod **108**, the lever **88** is pivoted in an anti-clockwise direction (with respect to FIGURE 2) thereby allowing the assembly of the bush **142**, the movable plate **132**, the magazine **30** and the rod **112** to move upwards with the pawl **98** under the action of the springs **140**; it will be appreciated that the balls **152** retain the stack of holders **10** remaining in the bush **142** and the magazine **30** in position relative to the bush **142** and the magazine **30**. Also, upward movement of the magazine **30** causes the slide block **44** to move upwards which in turn causes the members **48** and **60** to move upwards, the head **82** of the bolt **78** bearing against the bar **62**. The upward movement of the assembly of the bush **142**, the movable plate **132**, the magazine **30**, the rod **112**, the slide block **44** and the slidable members **48** and **60** continues until the bushes **136** come into contact with the lower face of the fixed plate **130**, and thereafter the pawl **98** moves upwards relative to this assembly until the piston rod **108** reaches its lowermost position, the weight of the rod **112** being sufficient to overcome the resistance of the spring **100** and thereby prevent further upward movement of the rod **112**. During this relative movement of the pawl **98** with respect to the rod **112**, the pawl **98** slides upwards over one tooth **124** of the rod **112**, and it should be appreciated that at the end of this cycle of operation the position of the rod **112** will be lower than its position at the beginning of the cycle of operation by a distance corresponding to the spacing of the valve holders **10** in the magazine **30**. Thus, at the commencement of the next upward stroke of the piston rod **108** the pawl **98** engages with that tooth **124** immediately above the tooth **124** engaged by the pawl **98** during the immediately preceding cycle of operation.

After a short interval, the next printed circuit panel is moved into position beneath the mechanism and the cycle of operation is repeated.

It will be appreciated that, in operation of the mechanism, the length of the stroke of the rod **108** remains substantially constant, so that the pressure exerted on the stack of holders **10** while a holder **10** is being inserted into a printed circuit panel also remains substantially constant from one cycle of operation to the next. Also, it should be appreciated that, in the mechanism described above, the length of the stroke of the piston rod **108** can be arranged to be relatively short thereby enabling the duration of each cycle of operation of the mechanism to be made relatively short. On the other hand, if the piston rod **108** were arranged to act directly on the stack of holders **10**, the rod **108** would not exert constant pressure on the stack of holders **10**, while the length of the stroke of the piston rod **108** would increase for each successive cycle of operation.

I claim:

1. A feed mechanism for use in mounting similar articles on support members, said mechanism including a container which is elongated and is open at both ends, the container being adapted to contain a plurality of similar articles abutting against one another in an orderly succession extending along the length of the container, a ram which is arranged to bear against an end one of the succession of articles, a reciprocable member which in operation has a substantially constant length of stroke and which is coupled to the ram by a linkage at least partly constituted by a ratchet and a pawl mechanism whereby during each forward stroke of the reciprocable member the articles in the container are pushed lengthwise through the container over a distance substantially equal to the spacing of the articles in the container, and power means for reciprocating said reciprocable member.

2. A feed mechanism according to claim 1, in which at least a major part of the container is readily removable from the remainder of the mechanism.

3. A feed mechanism according to claim 1, including

means whereby during a first part of a forward stroke of said reciprocable member the container moves lengthwise with the ram, means for arresting movement of the container upon the completion of said first part of said forward stroke such that thereafter during said forward stroke the ram continues to move so as to push the articles in the container lengthwise through the container, and means for causing the container to return to its initial position during the return stroke of said reciprocable member.

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