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United States Patent [19]

Eggerman

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[54] BEE NEST STRIPPER

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[73] Assignee: Eggerman Farms Ltd., Watson, Canada

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[30] Foreign Application Priority Data

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[51] Int. Cl.[5] A01K 51/00

[52] U.S. Cl. 449/1; 449/56; 449/61

[58] Field of Search 449/1, 4, 52, 56, 61; 15/104.02, 104.05, 104.011, 104.012

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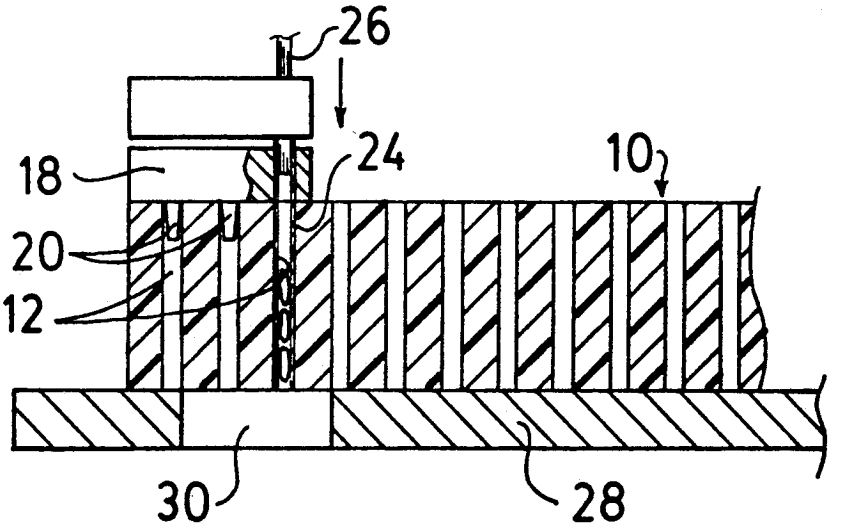
Attorney, Agent, or Firm—Murray E. Thrift; Stanley G. Ade; Adrian D. Battison

[57] ABSTRACT

A hole in a leafcutter bee nest is stripped by pushing a thin tube into the hole to separate larvae in the hole from the surrounding nest material. An ejector, for example a rod sliding in the tube, is used to eject the separated larvae and cocoons. The method is carried out using an apparatus with foot guides for engaging a nesting block and aligning the tubes with a row of holes in the block, and a sequential drive. The drive first pushes the tubes through the block then drives the rods through the tubes. The tubes and rods are then withdrawn. The foot guide is subsequently lifted out of engagement with the nesting block and the block is indexed one hole forwards for stripping of the next row of holes.

19 Claims, 7 Drawing Sheets



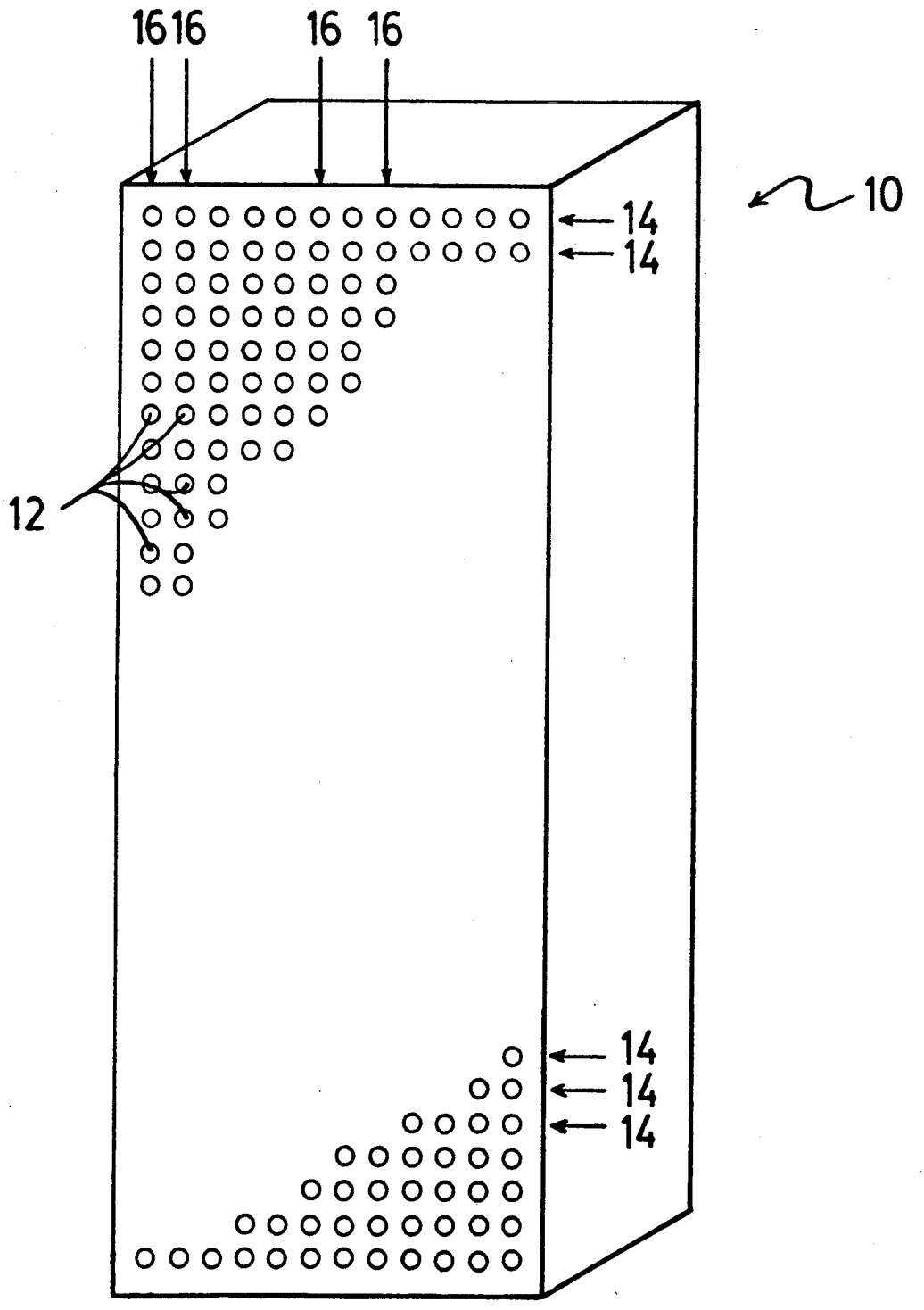


FIG. 1

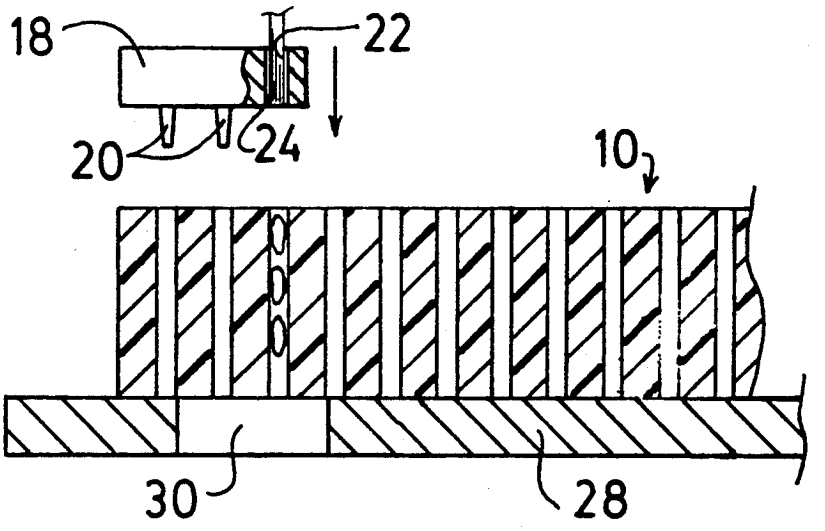


FIG. 2

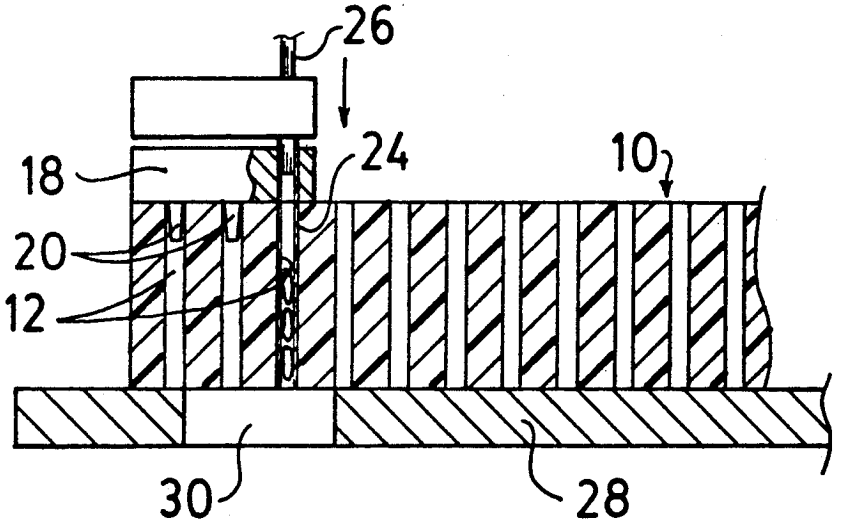


FIG. 3

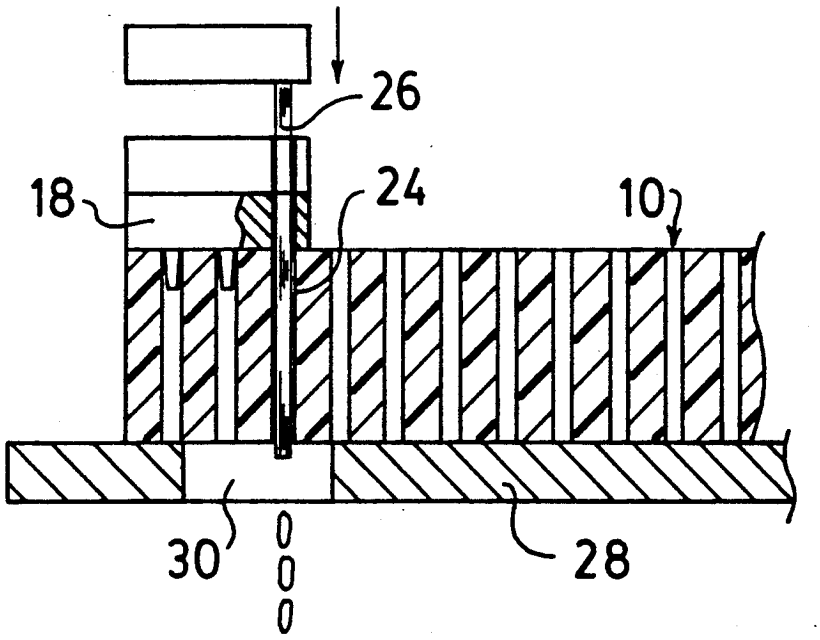


FIG. 4

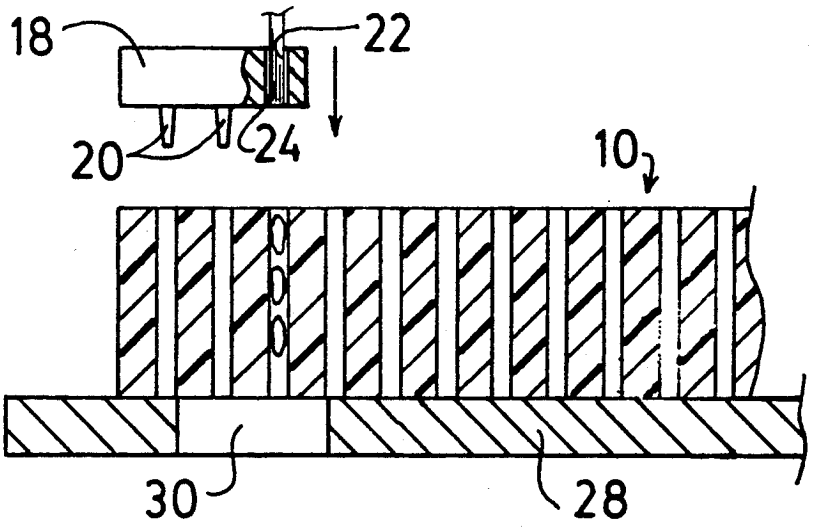


FIG. 2

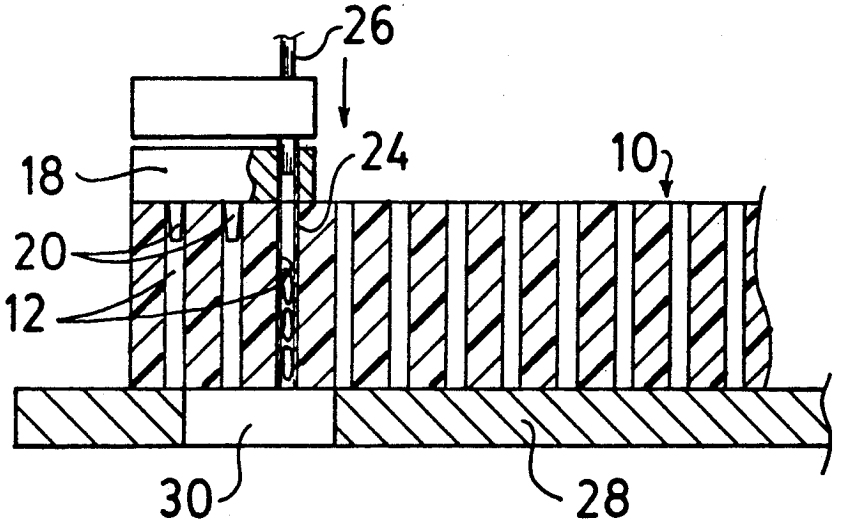


FIG. 3

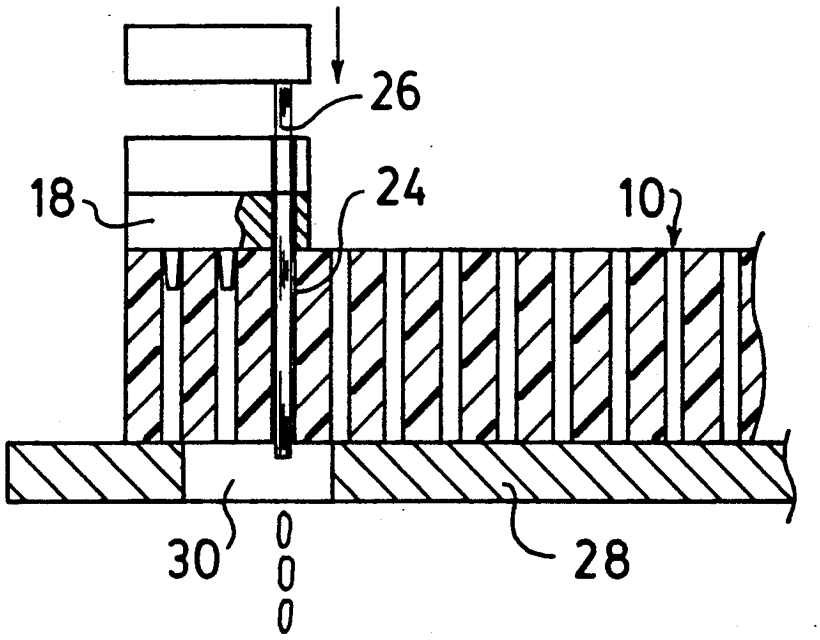


FIG. 4

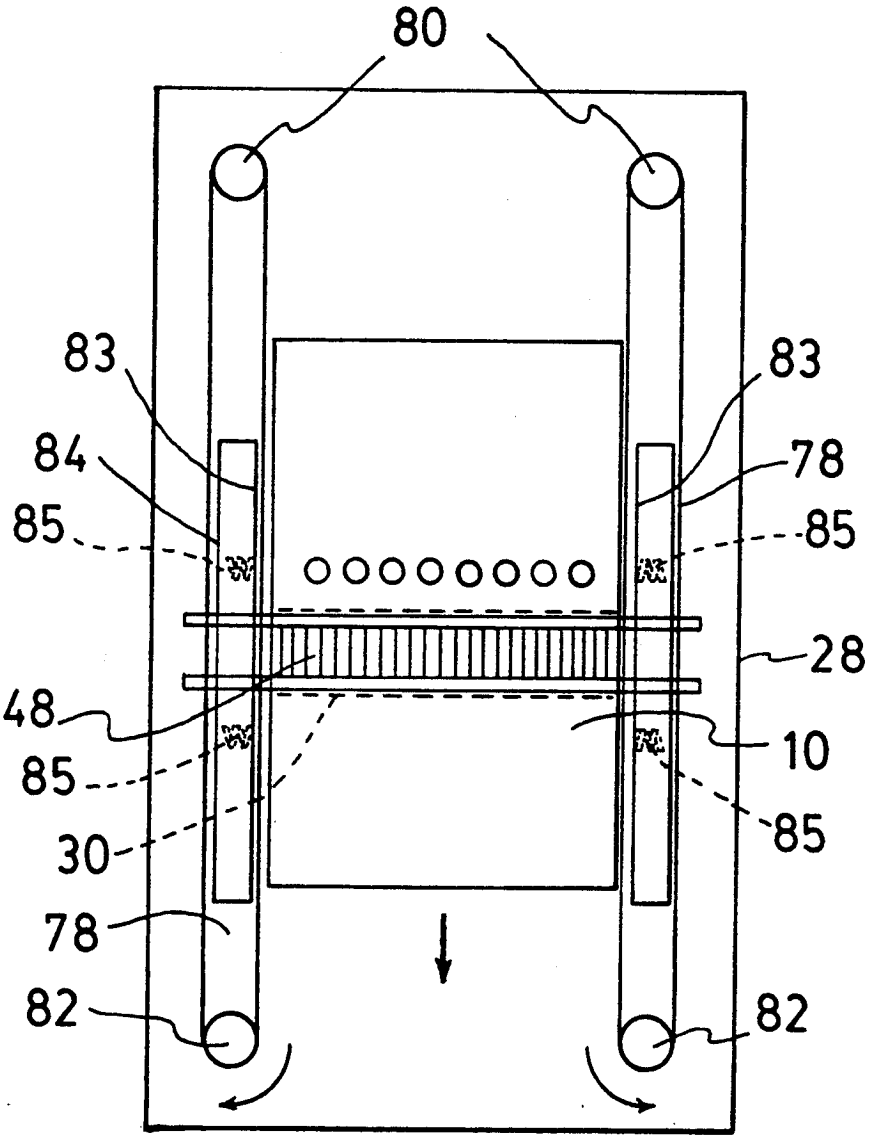


FIG. 7

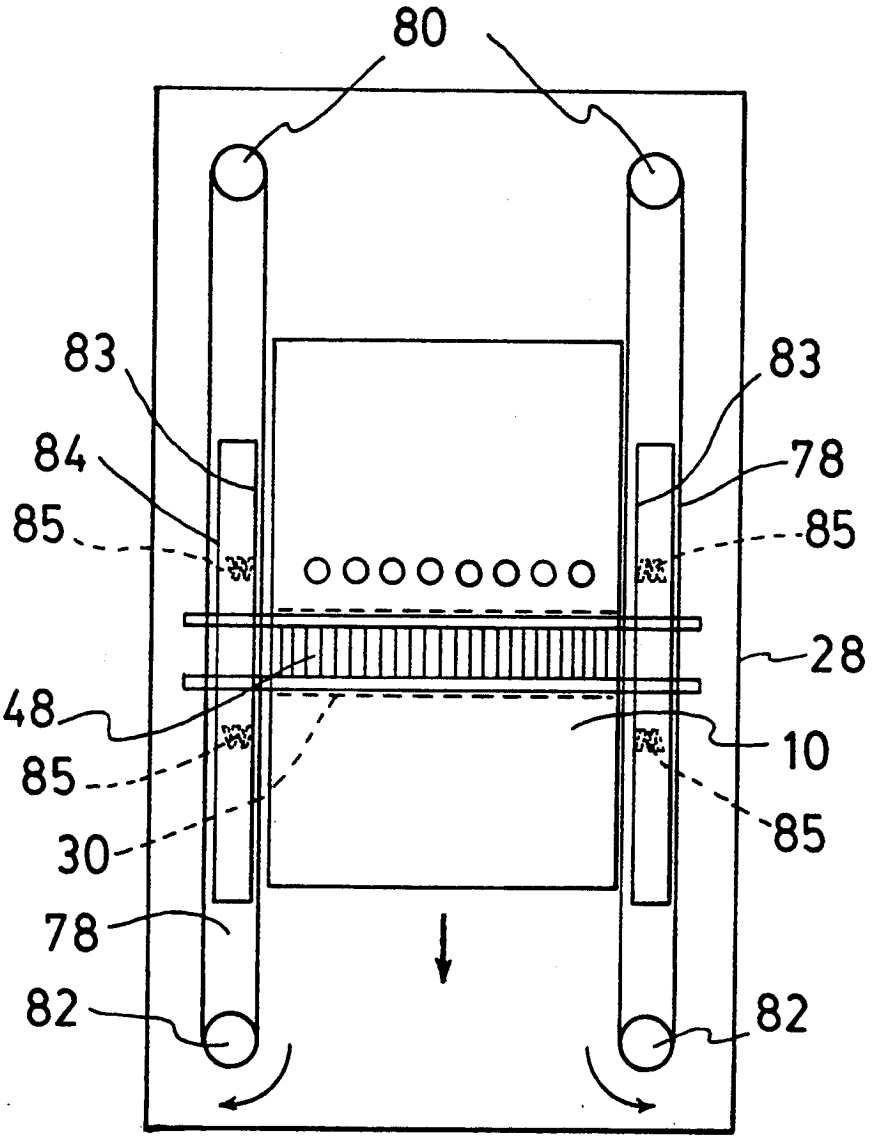


FIG. 7

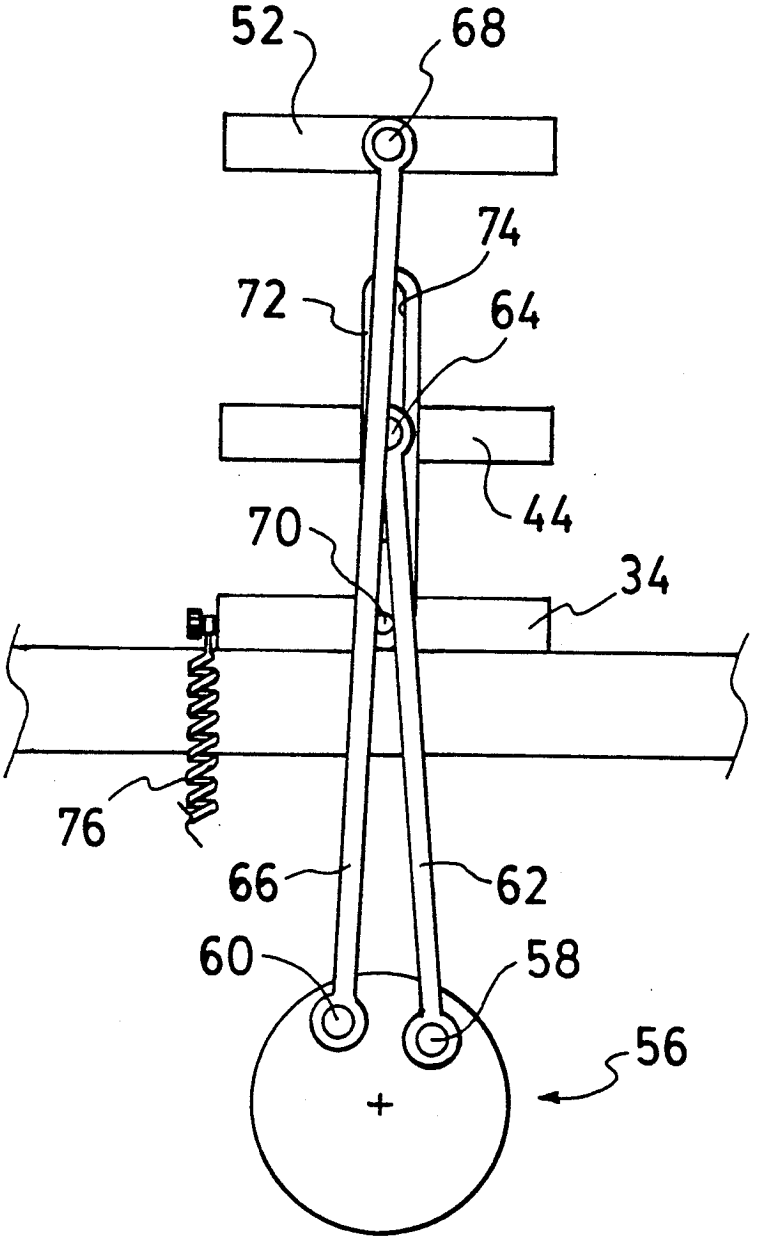


FIG. 9

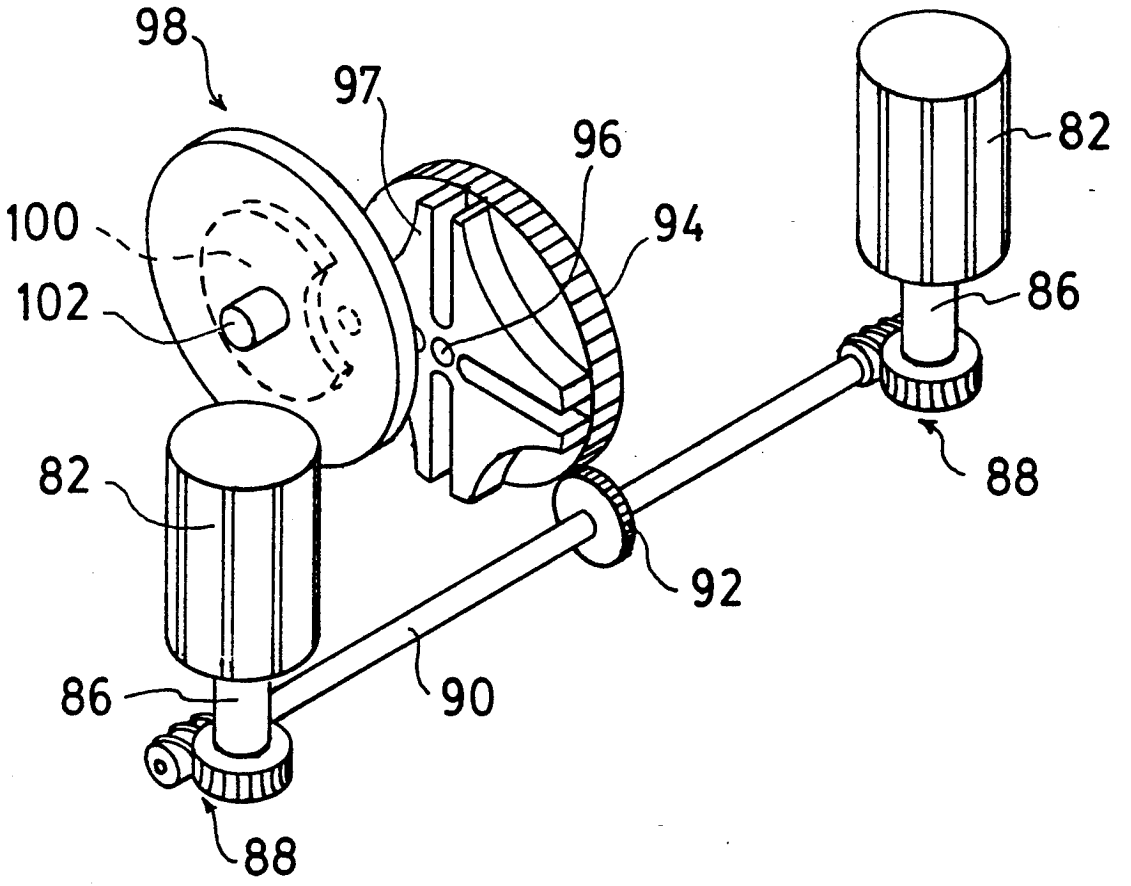


FIG. 10

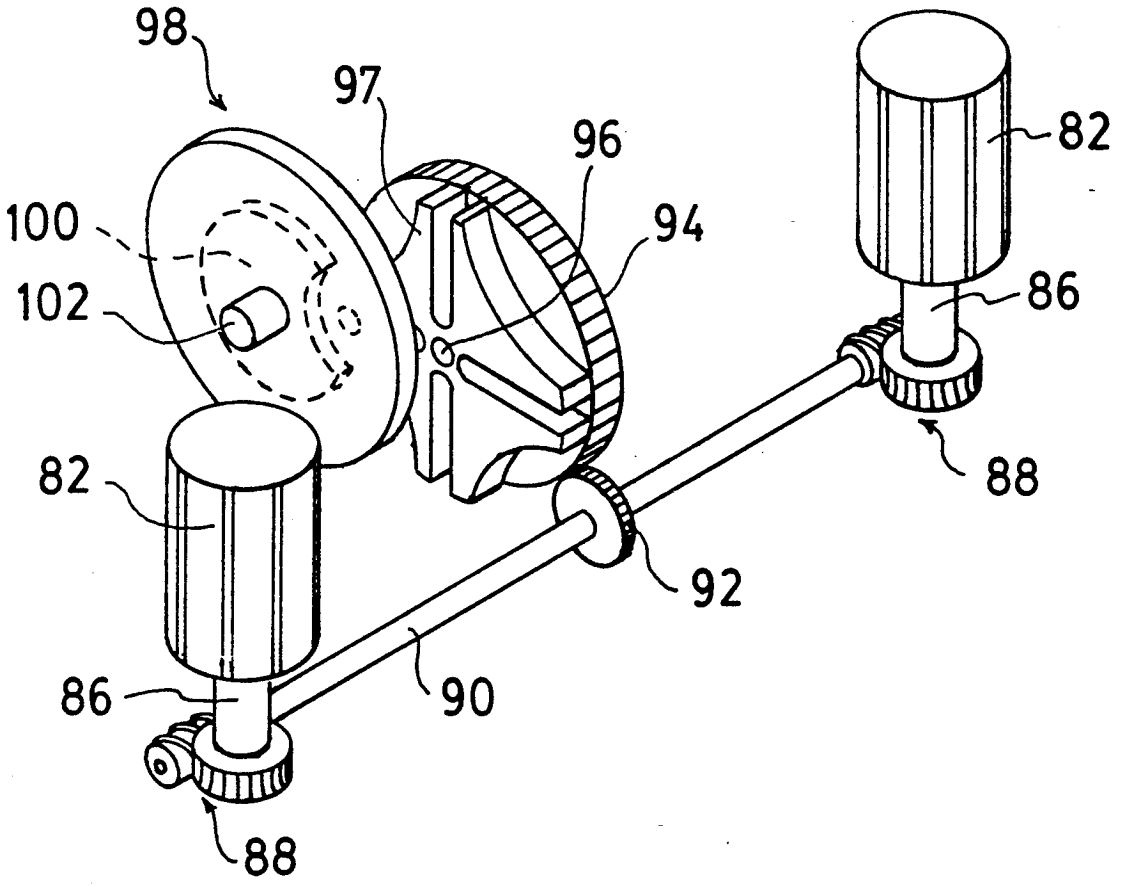


FIG. 10

nels 32 so that they can move freely, within limits, over the bed. This arrangement, in conjunction with guide pins 20 with a taper of about one in three allows the pins to engage the holes in the nest block even if the nest block and foot guide are out of alignment by as much as say three to four millimeters.

The channels 32 are secured together at their opposite ends by connector bars 34 that project beyond the ends of the channels 32 and carry large bushings 36 engaged slidably on respective vertical columns 38 on opposite sides of the bed. The columns thus guide the entire foot guide assembly for vertical movement during operation of the apparatus.

Each of the tubes 24 is connected to a tube holder 40 in the form of a rectangular block. Like the foot guides, the tube holders are arranged side by side across the apparatus and are retained in a pair of tube holder channels 42 fixed together by connector bars 44 at the opposite end. The connector bars project beyond the ends of the channels 42 and carry bushings 46 to engage on the respective columns 38.

Rods 26 are individually connected to rod holders 48 in the form of rectangular blocks arranged side by side across the apparatus and held in place by rod holder channels 50 coupled by connector bars 52. The rod holder connector bars carry respective bushings 54 that engage slideably on the columns 38.

Vertical movements of the foot guides 18, the tubes 24 and the rods 26 are controlled by two symmetrically arranged crank mechanisms, one on either side of the apparatus. Each crank 56 includes two throws 58 and 60 spaced 45° from one another. The connecting rod 62 is connected to the leading throw 58 and to a wrist 64 on the adjacent tube holder connector bar 44. A connecting rod 66 is coupled to the trailing throw 60 and to a wrist pin 68 on the rod holder connector bars 52.

The foot guides are not operated directly by crank but rather indirectly through the motion of the tube holders. The connector bars of the foot guide assembly have pins 70 projecting from their ends, carrying respective lift links 72. The lift links have elongate slots 74 engaging over the wrist pins 64 of the tube holder assembly. The foot guide assembly is biased to a lowered position by hold down springs 76 connected to the foot guide connector bars.

In operation, rotation of the crank 56 causes the wrist pins 64 to engage the top of the slot 74 to lift the guide assembly so that the pins 20 are clear of the holes in the nest block. Continued rotation of the crank to turn the throw 50 beyond top dead centre begins to lower the foot guide assembly to allow the pins 20 to engage holes in a nesting block supported on the bed 28 of the apparatus. The hold down springs pull the foot guide snugly down until the tapered pins are in a tight fit with the associated holes of the nesting block. At this time, the tube guide holes 22 in the foot guides are in alignment with the holes 12 of the nest block immediately following the foot guide pins 20. The continued rotation of the crank 56 lowers the tubes through the foot guide holes and the holes in the nesting block. Following this movement, 45° out of phase, is a similar movement of the rods 26 through the tubes 24.

The nesting blocks are advanced along the bed, past the stripping station by a pair of opposed timing belts 78 engaging opposite sides of the block. Each belt runs over an idler sprocket 80 at one end of the bed and drive sprocket 82 at the other. Between the two sprockets are backing plates 83 mounted on support blocks 84 by bias springs 85. These force the belts into engagement with the opposite sides of the nesting block.

Each of the drive sprockets 82 has a drive shaft 86 that extends through the bed of the stripper for connection to a worm gear reducer 88. The two worm gear reducers are connected by a cross shaft 90 driven by a gear 92 from a drive gear 94. Gear 94 is mounted on a common shaft 96 with the indexing wheel 97 of a geneva wheel mechanism 98. The rotor 100 of the geneva wheel mechanism is mounted on a shaft 102 driven continuously from an electric motor 104 that also supplies power for the crank 56.

In operation of the apparatus, the rotation of the crank 56 acts, through the connecting rod 62 and the wrist pin 64 to lift the foot guide and its tapered pins 20 out of engagement with the nesting block. As the wrist pin 64 reaches top dead centre, the geneva wheel engages to index the timing belts forwards by one step, thus advancing the nest block past the stripping station a distance equal to the spacing between two adjacent rows of holes. The geneva wheel then enters an idle phase, holding the nesting block in position, while the crank continues to rotate, lowering the wrist pin 64 and allowing the foot guide pins 20 to engage holes in the nesting block to align the tub guide holes 22 with the next following nest block hole. The tubes are then drawn down into the holes in the nesting blocks, followed, at a 45° phase lag, by the rods 26 descending through the tubes. At the bottom dead centre position of crank throw 58, the tubes 24 begin to rise out of the block, while the rods 26 continue to descend, driving all collected material out of the tubes and through the opening 30 in the bed. The tubes and pins are withdrawn as the crank continues to rotate, with the elevation of the tubes drawing the foot guide 18 upwardly through the action of the wrist pin 64 on the lifting links 72. The block is then indexed once more and the complete stripping cycle repeated.

The foot guides, the tube holders and the rod holders are held within their respective channels with a clearance fit of 0.25 to 0.5 millimeters. This allows the stripping components to move slightly so that the points of the tapered pins 20 will enter the intended holes in the nest blocks even if they are three to four millimeters out of alignment.

While one embodiment of the present invention has been described in the foregoing, it is to be understood that other embodiments are possible within the scope of the invention. For example, the driving mechanism for sequentially inserting the guide pins, the tubes and the ejection rods may be configured as two slider-crank mechanisms rather than a crank and connecting rod arrangement. The intermittent feed may be produced by mechanisms other than the geneva wheel illustrated, for example, an indexing wheel driven by an indexing pin on a rotor. Non-mechanical systems will also be apparent to those knowledgeable in the art.

It is also possible to use a shorter tube in order to separate only the outer one-third to one-half of the hole contents from the next block, although this is not considered to be as satisfactory. A separate ejector, not sliding in the tube, is also possible. In the past attempts have been made to use an air blast for stripping nests. This has not proven satisfactory, but may prove useful as an ejection means in conjunction with the separating tube. The invention is therefore to be considered limited solely by the scope of the appended claims.

I claim:

1. A method of stripping larvae from a hole through a leaf cutter bee nest, said method comprising:

extending into the hole a tube having a close fit in the hole and thereby separating larvae from the nest around the hole; and

ejecting the larvae from the hole.

2. A method according to claim 1 comprising extending the tube through the hole.

3. A method according to claim 1 comprising ejecting the larvae by extending a rod through the tube.

4. A method of stripping larvae from a leafcutter bee nest having at least one row of holes therethrough, the method comprising:

extending substantially simultaneously through a plurality of the holes, respective ones of a plurality of tubes each having a close fit in the respective hole and thereby separating larvae from the nest around the hole; and

subsequently simultaneously extending a plurality of rods through respective ones of the tubes.

5. A method according to claim 4 wherein the nest comprises a nest block with a plurality of holes therethrough, arranged in rows and columns, said method comprising:

a) aligning the holes of a first row of the holes with respective ones of the tubes;

b) extending the tubes simultaneously through the holes aligned therewith;

c) extending the rods simultaneously through respective ones of the tubes;

d) withdrawing the rods from the tubes and the tubes from the holes;

e) moving the nest block relative to the tubes to align the holes of a subsequent row of holes with respective ones of the tubes; and

f) repeating steps b) to e) for each subsequent row of holes.

6. A stripper for a leaf cutter bee nest having at least one row of holes therethrough, the stripper comprising:

a plurality of tubes corresponding in number and spacing to the holes in said at least one row of holes, each tube being shaped and sized to fit closely into a hole in the nest;

tube driving means for driving the tubes into respective ones of the holes in the nest to separate larvae therein from the nest surrounding the holes; and

ejection means for ejecting larvae from the holes.

7. Apparatus according to claim 6 wherein the ejection means comprise a plurality of ejection rods corresponding to respective ones of the tubes.

8. Apparatus according to claim 7 wherein each ejection rod is shaped and sized to fit closely into the associated tube.

9. Apparatus according to claim 8 wherein the ejection means further comprises rod driving means for driving the rods through the tubes.

10. Apparatus according to claim 9 wherein the nest block comprises plural rows of holes arranged in sequence and the stripper includes block advancing means for moving the nest block stepwise relative to the tubes to bring the sequential rows of holes into alignment with the tubes.

11. Apparatus according to claim 10 wherein the tube driving means comprise means for driving the tubes simultaneously through the respective holes of a row and the rod driving means comprise means for driving the rods simultaneously through the respective tubes.

12. Apparatus according to claim 11 wherein the block advancing means comprise timing belts for engaging opposite sides of a nest block and means for driving the timing belts.

13. Apparatus according to claim 12 wherein the means for driving the timing belts comprise a geneva wheel intermittent drive.

14. Apparatus according to claim 14 including alignment means for aligning the tubes with the respective holes of a row of holes.

15. Apparatus according to claim 14 wherein the alignment means comprise a foot engaged with the tubes, alignment pins on the foot, and foot setting means for moving the alignment pins relative to a nest block for engaging the alignment pins with respective holes in the nest block.

16. Apparatus according to claim 15 wherein the alignment means include mounting means mounting the tubes and the ejection rods for movement together with the alignment pins whereby the tubes and ejection rods may be brought into alignment with the holes of a selected row in response to engagement of the alignment pins with respective holes in the nest block.

17. Apparatus according to claim 16 wherein the alignment pins are tapered.

18. Apparatus according to claim 17 wherein the mounting means include tube holder carrying the tube, rod holder means carrying the ejection rods and support means supporting the tube and rod holder means and the foot for limited free movement laterally of the holes.

19. Apparatus according to claim 18 wherein the support means comprise channels engaged with opposite edges of each tube and rod holder means.

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