United States Patent [19]

Elmer

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[54] **CONTINUOUS MOTION TWO PART ASSEMBLY MACHINE**

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[73] Assignee: **Inventors Engineering Inc.**, Minneapolis, Minn.

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[52] **U.S. Cl.** ..... **29/208 B**, 29/208 E, 29/208 F

[51] **Int. Cl.** **B23p 19/04**

[58] **Field of Search** ..... 29/208 B, 208 C, 29/208 F, 208 R, 208 D, 211

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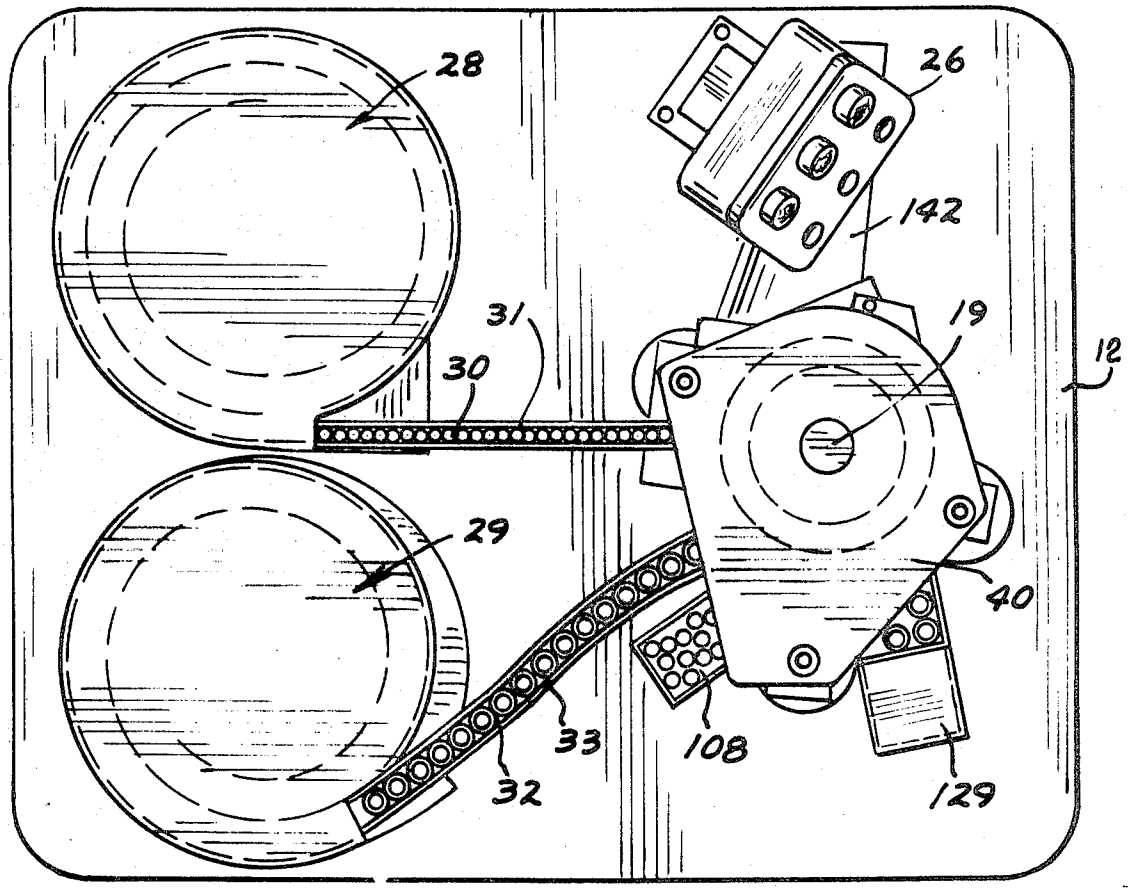
Primary Examiner—Thomas H. Eager

Attorney—Ralph L. Dugger, Nickolas E. Westman, et al.

[57] **ABSTRACT**

A continuous motion two part assembly machine comprising a rotatable turntable adapted to pick up parts to be assembled at provided locations at the periphery and which turntable carries the parts in a continuous motion. Plunger actuators are mounted for movement with said turntable, and can be operated by a stationary cam to first determine the presence and proper configuration of a first of said parts, rejecting a first of said parts not of proper configuration, removing a second of said parts carried thereby in the absence of the corresponding first part, assembling properly configured first parts with second parts, counting the assemblies made, and subsequently removing the assembled parts from the unit. In addition, if a second part is missing, the first parts are sorted from the assembled parts after removal from the turntable. The unit comprises a continuous motion pick up, inspection, assembly and removal of parts utilizing cam operated working elements or plungers.

19 Claims, 9 Drawing Figures



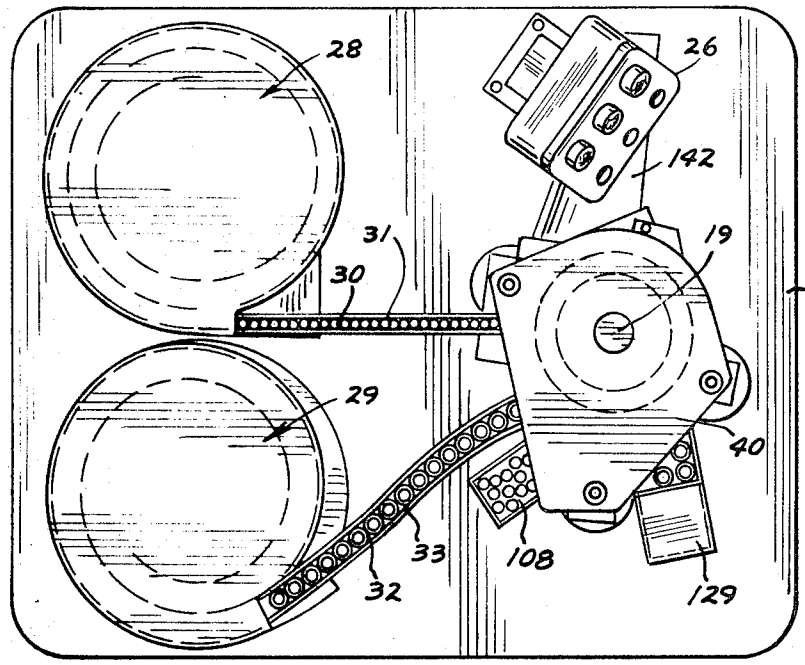

28
26
142
31
19
12
30
29
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33
108
32
129

FIG. 1

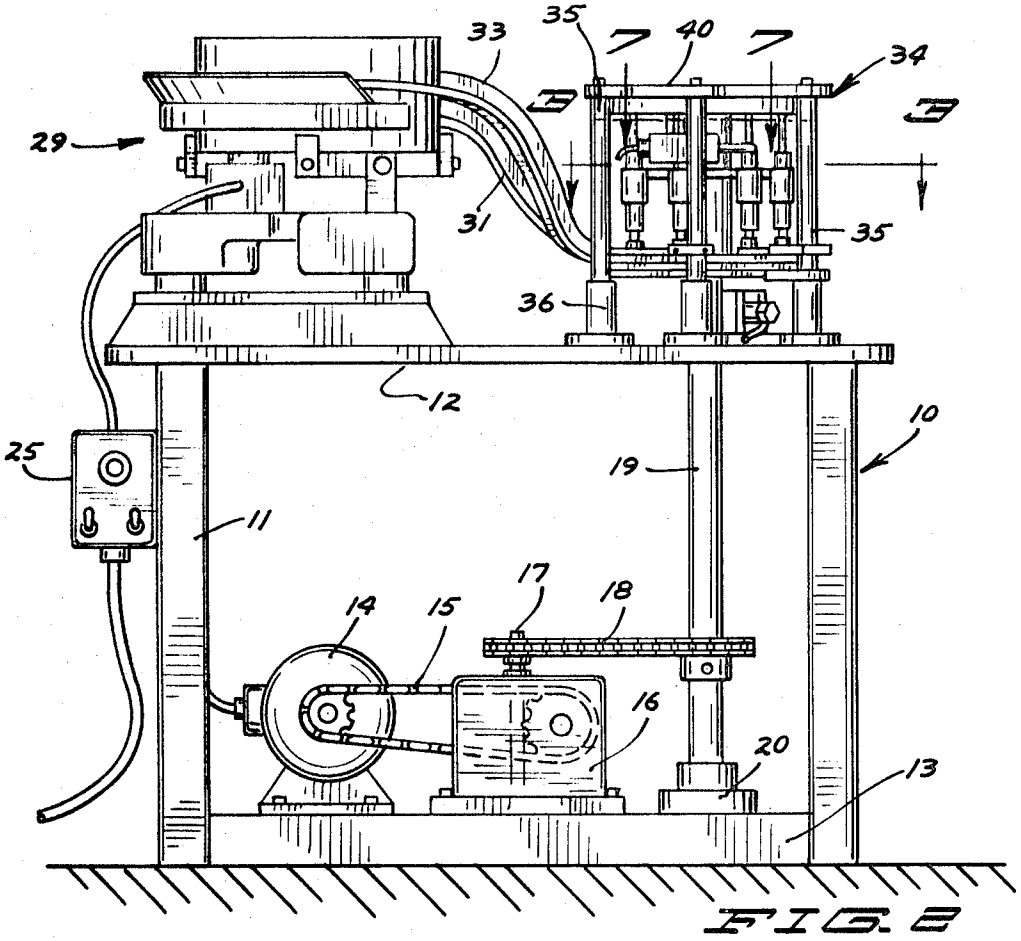

33
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FIG. 2

FIG. 3

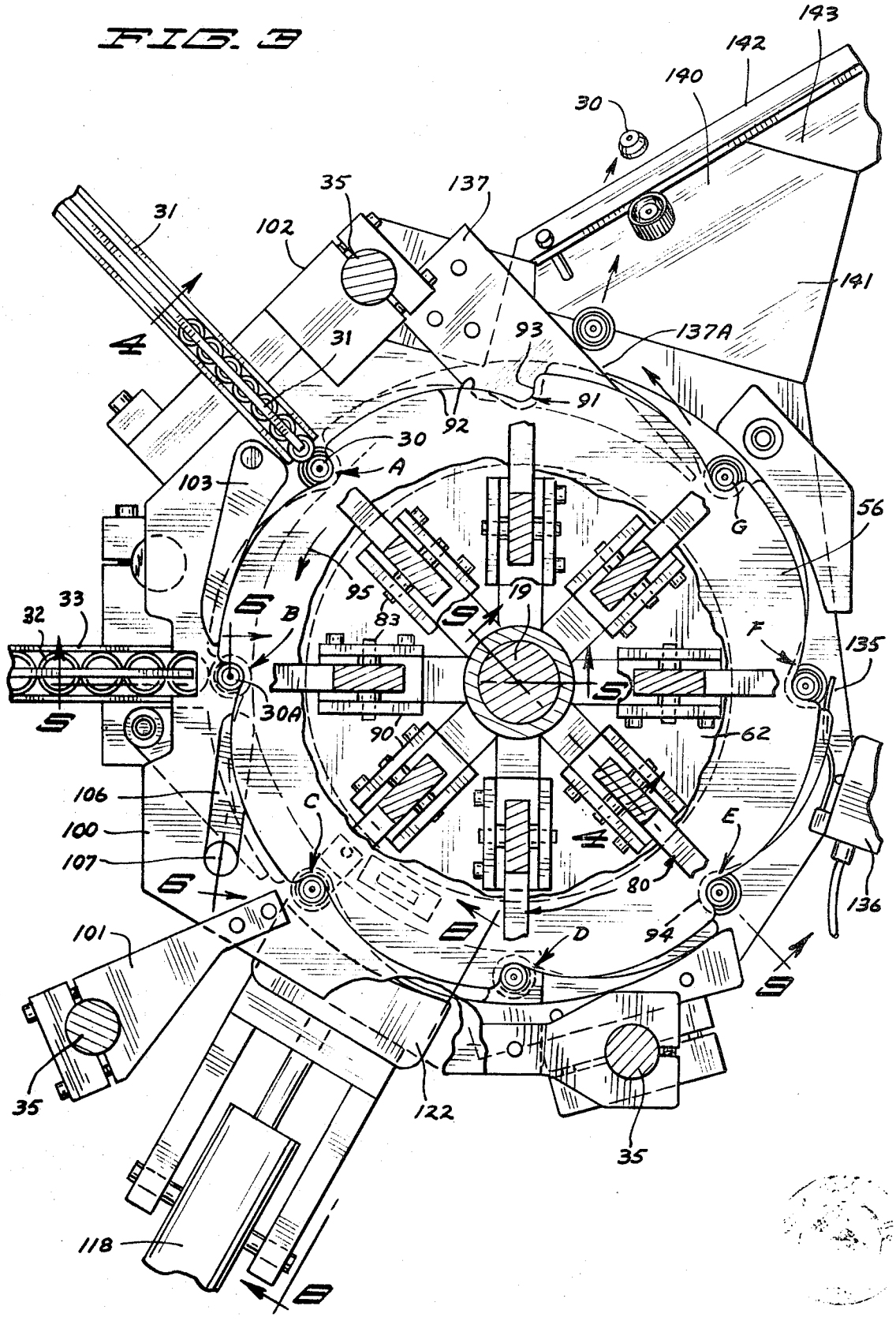
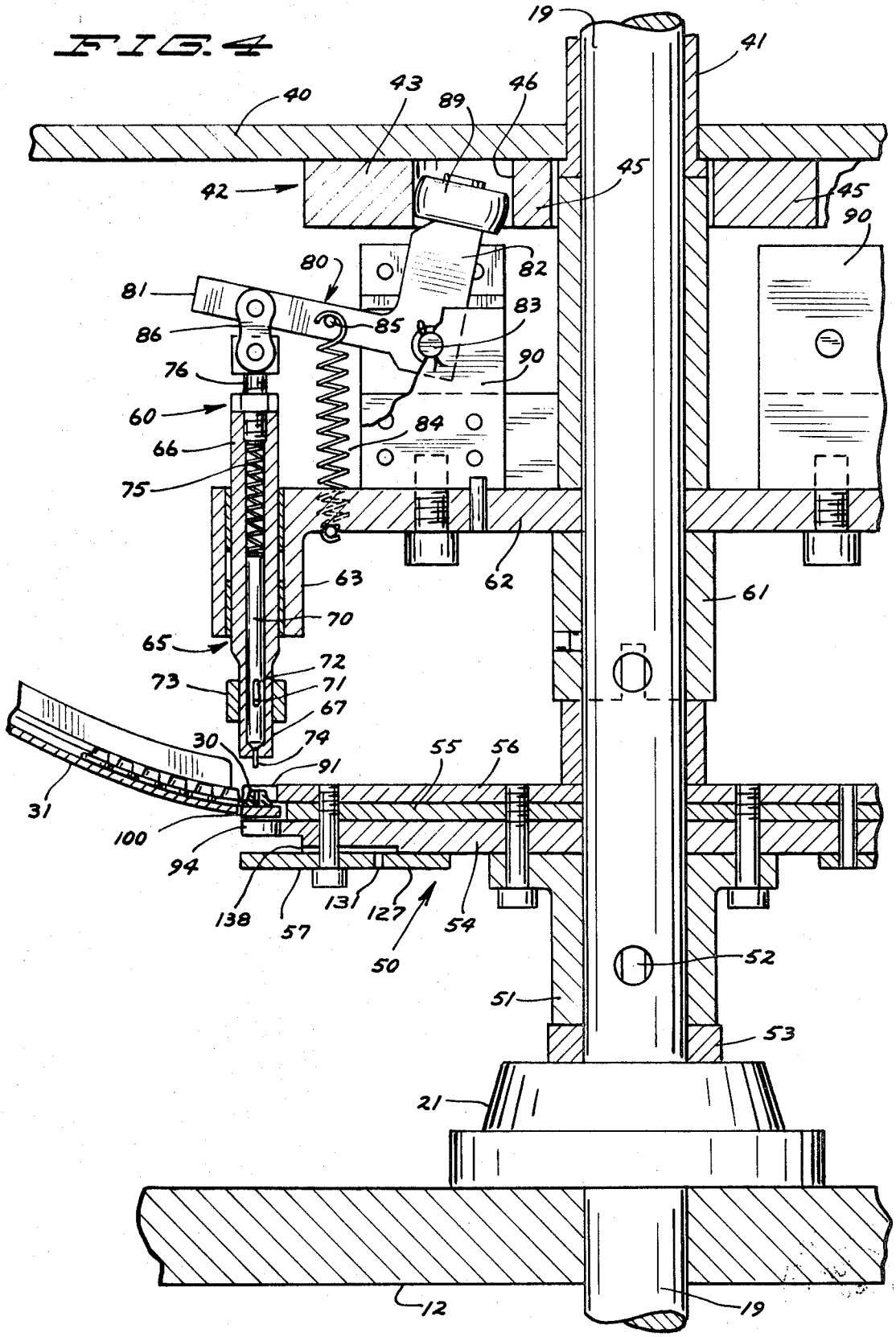

143
142
140
30
35
137
31
102
141
137A
93
91
92
30
A
103
56
G
95
19
B
83
32
33
F
135
30A
90
62
106
C
E
100
107
80
136
101
D
94
35
122
35
118
B

FIG. 4


19
41
40
43
89
46
42
45
45
90
80
82
81
83
86
85
90
76
60
84
66
75
63
62
61
70
65
72
73
71
67
74
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91
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138
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131
127
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53
21
12
19

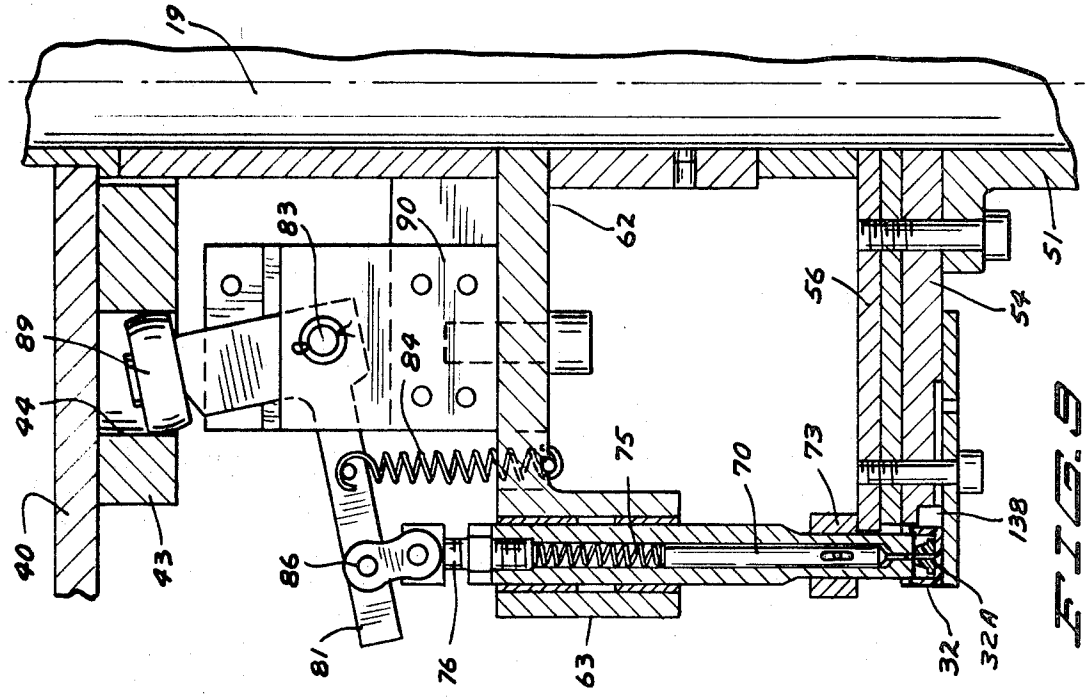

19
83
90
62
51
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54
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75
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138
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43
86
81
76
63
32
32A

FIG. 4

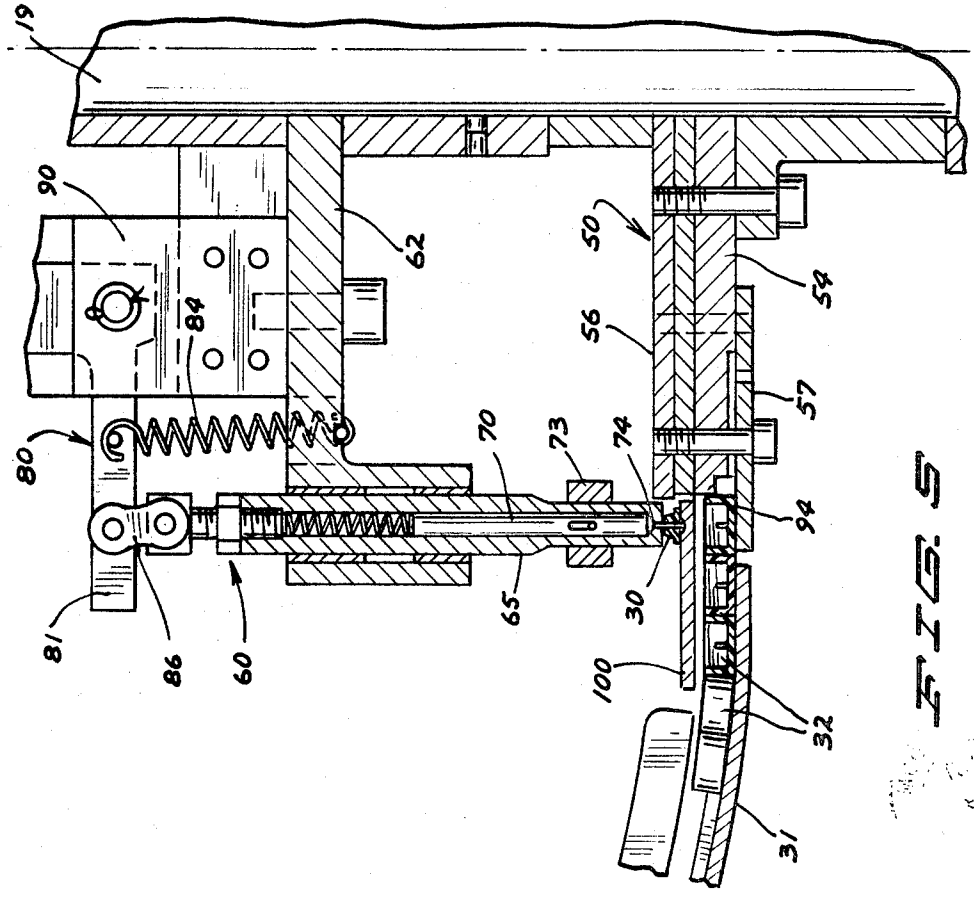

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FIG. 5

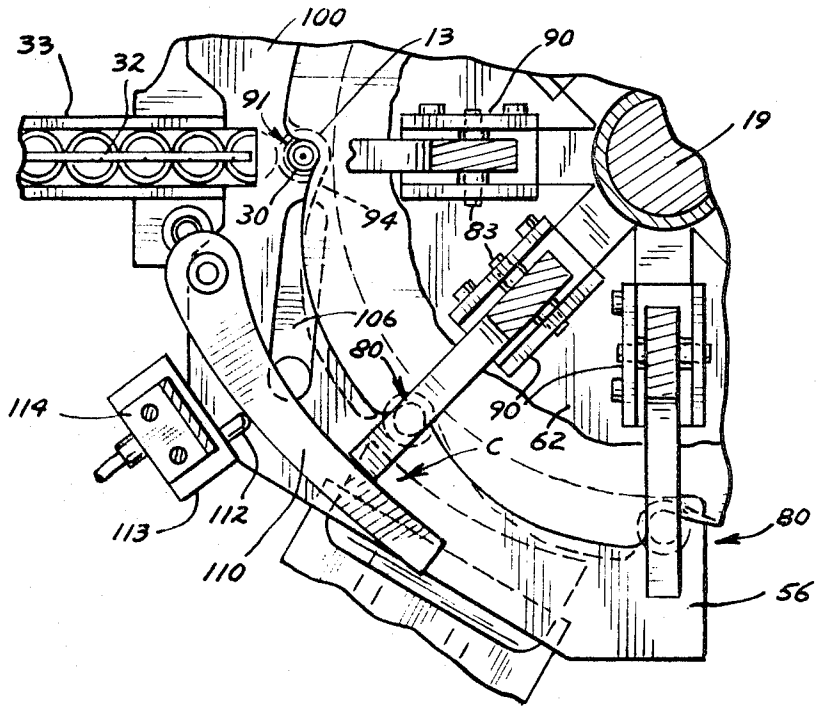

100
13
90
33
32
91
19
30
94
83
106
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114
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62
C
80
113
112
110
56

FIG. 7

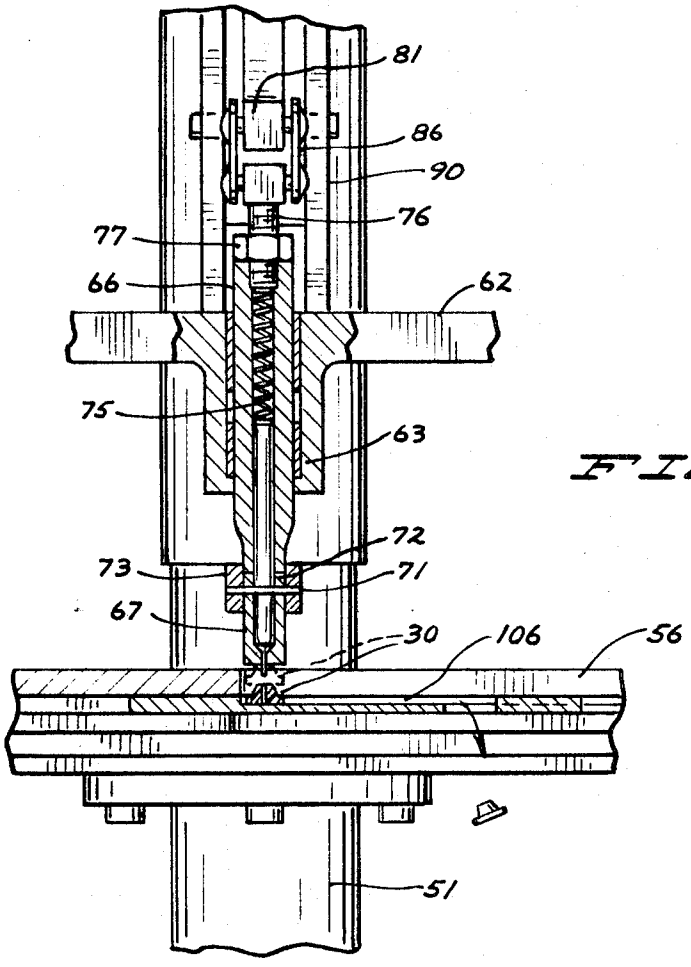

81
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72
73
71
67
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56
51

FIG. 6

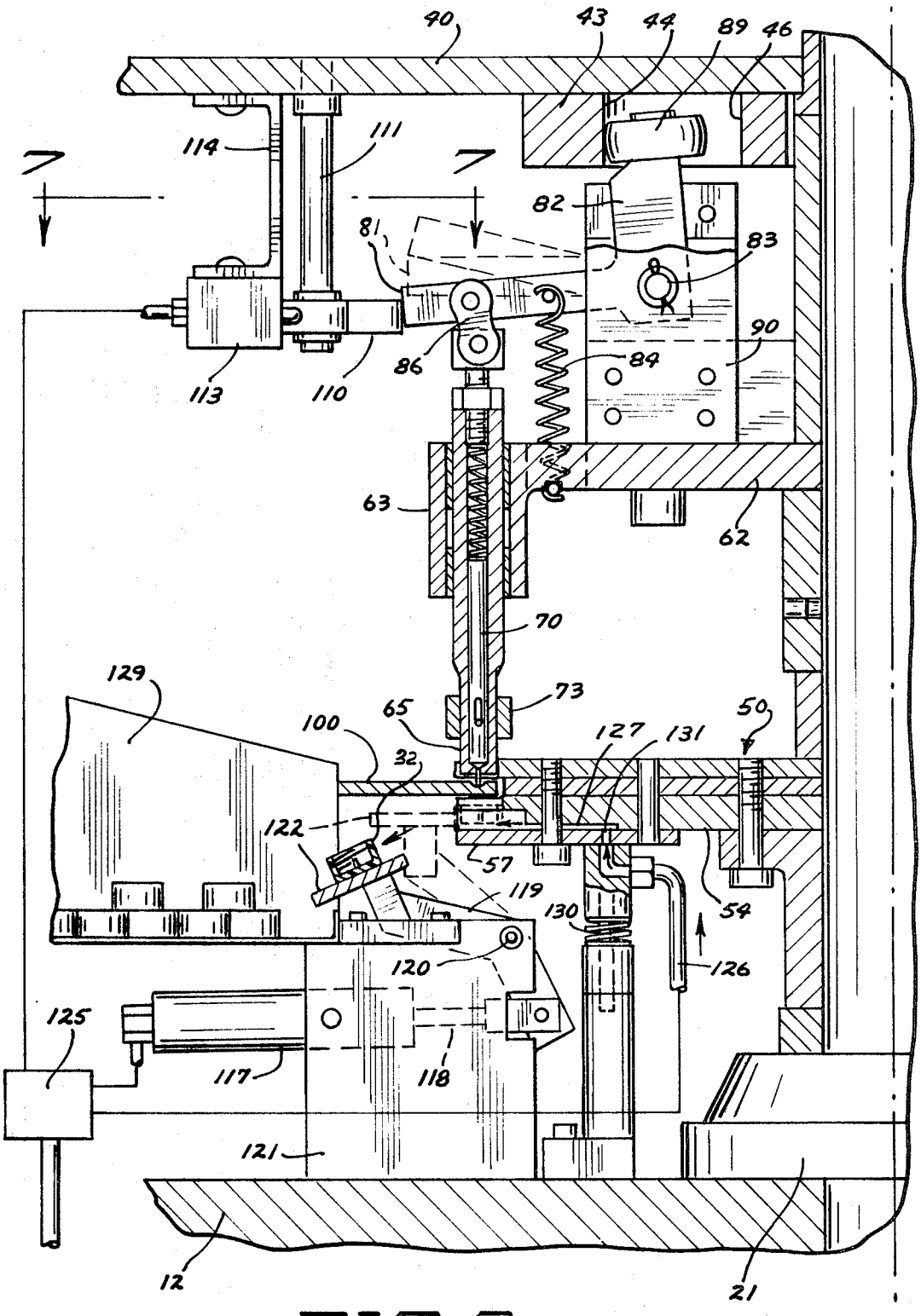

40
43
44
89
46
114
111
7
7
82
81
83
90
84
86
113
110
63
62
70
129
73
65
50
100
127
131
32
122
57
119
130
54
120
126
125
117
118
121
12
21

FIG. 8

CONTINUOUS MOTION TWO PART ASSEMBLY MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to assembly machines operating in a continuous motion cycle.

2. Prior Art

In the prior art, assembly machines have usually been intermittent motion, or when continuous motions have been utilized, problems have arisen with the proper inspection of the parts being assembled, as well as proper sorting of defective parts. Other prior devices include drums rotating about a horizontal axis in a waterfall motion, but a limited number of inspection and assembly stations are available unless the horizontal axis drums are very large. In the present device, continuous motion is applied to a two part assembly turntable, wherein at least one part is inspected for the proper configuration, and also for the presence of the parts, and are sorted so that only properly assembled, and properly configured parts are accepted.

SUMMARY OF THE INVENTION

The present invention relates to a turntable type continuous motion two part assembly machine. The machine is provided with a plurality of operating stations, and wherein the individual parts are deposited in separate stations. A first of said parts is inspected, and if defective is rejected. When the first of said parts is rejected, or if a first of the parts is missing, a corresponding second part is subsequently removed in response to a position signal of the operating elements on the turntable. The unit then moves to an assembly station, where two existing parts are assembled, the assembly is counted, and then the assembly is removed. If a second of the parts is missing, the first part is of such size that it will be sorted after final removal from the continuous motion turntable so that it will not go into the acceptable bin, and also, the counter is positioned so that if only a first part is present as it moves past the counter, the counter will not be actuated.

The working elements are reciprocating plungers operated from bell cranks that include cam rollers engaging a stationary cam. As the turntable rotates, the cams are easily actuated, so that high rotational speeds of the turntable can be achieved to insure rapid assembly of the part.

Individual parts are supplied by conveyors from vibratory feeders, and are picked up by the turntable as it rotates. Each of the pockets or part receiving receptacles on the turntable will carry the parts to various work stations for the inspection, reject, and assembly operations.

The unit is relatively inexpensive to make, is safe and sure in operation, and gives very high speed assembly for multiple part assemblies.

An object of the invention is to provide a turntable type continuous motion assembly machine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of the assembly machine made according to the present invention;

FIG. 2 is a side elevational view of the device of FIG. 1;

FIG. 3 is a fragmentary enlarged sectional view taken as on line 3—3 in FIG. 2;

FIG. 4 is a sectional view taken as on line 4—4 in FIG. 3;

FIG. 5 is a sectional view taken as on line 5—5 of FIG. 3;

FIG. 6 is a sectional view taken as on line 6—6 in FIG. 3;

FIG. 7 is a sectional view taken as on line 7—7 of FIG. 2 and also as on line 7—7 in FIG. 8;

FIG. 8 is a sectional view taken as on line 8—8 in FIG. 3; and

FIG. 9 is a sectional view taken as on line 9—9 in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 and 2, a general layout of the continuous motion two part assembly machine is illustrated. The machine has a turntable or revolving carousel which rotates about a substantially vertical axis, as shown, and includes a support frame member 10, that has support legs 11, a table top 12, and a base 13. There is an electric motor 14 of usual design driving through a chain assembly 15 to a gear reduction box 16 mounted on the base 13. The output shaft 17 of the gear box drives through a sprocket and chain 18 to an upright main power drive shaft 19 that is rotatably mounted in a suitable bearing 20 on the base 13, and also in a suitable bearing 21 on the table. The bearing 21 is shown perhaps best in FIG. 4.

Suitable main power controls illustrated at 25 can be used for operating the motor 14, and putting it into operation. The controls are only illustrated very schematically in the present invention because they basically are conventional, and include the usual safety interlocks and the like. However, the inspection station controls will be explained in more detail. A control panel 26 is mounted above the table top and includes indicator lights for indication when part supplies are exhausted, manual cycle buttons, automatic cycle controls, and fuses and the like.

As stated, the unit is utilized for assembling, as shown, at least two parts that are nested together. As shown, the parts comprise caps for small juice containers which include a screw cap that goes on the outside of the container neck, and an insert will fit into the interior of the neck of the container, the insert has a small opening therethrough. The insert actually is forced into the filler neck opening of the juice container the first time the screw cap is placed onto the container. After that the insert stays in the container so that the small opening in the insert forms the orifice for squeezing out juice. The nested assembly of insert and caps makes the final installation easy to do. Many of these juice containers are a form shaped like lemons and limes, and contain juice from lemons and limes. The screw cap then is the cover that the user removes, and the insert remains in the neck of the opening of the container so that the small orifice permits a limited quantity of juice to be dispensed as desired. The cap and insert are made of resilient plastic.

Of course this is merely an illustrative example of parts which can be assembled in the general configuration, using the continuous carousel or turntable motion, with inspection and rejection of defective parts. The unit has particular adaptation for assembling parts wherein one of the parts nests inside the other or fits with the other in some way, and includes some type of

inspection requirements. For example, where one of the parts such as the insert, has to have some special configuration such as an orifice or hole in it.

The parts as shown are each provided from a separate bowl type storage hopper that has a vibratory conveyor of conventional design thereon. A first hopper comprising the insert supply is illustrated at **28**, and a second hopper comprising the outer screw cap supply is illustrated at **29**. These hoppers employ conventional vibrators, which vibrate the part along an annular path along the periphery of the bowl, and out along guideways or chutes that are provided. For example, the inserts **30** are vibrated out from the supply hopper **28** along downwardly extending guideway **31** so that the parts are moved along the guideway **31** under gravity and vibration to a first loading station indicated at A. The parts **32** comprising the outer, part which in this instance are screw caps, go down along a guideway **33** to a second loading station indicated at B.

The assembly portion of the machine as shown also includes a subassembly frame **34**. This frame **34** is comprised of a plurality of upright support columns **35**, each mounted in a hub **36** as it is attached to the table top **12** in a conventional manner. The columns **35** are used to support a stationary shelve and other operating items that are associated with the rotating carousel type assembly machine. Also, the columns **35** support a stationary upper plate **40** through which the shaft **19** extends, and there is a bushing **41** for the shaft **19** mounted on plate **40**. The plate **40** is affixedly mounted to these columns **35**, and supports a double surface cam assembly **42**. The cam assembly **42** is mounted under the plate **40** and includes an outer ring **43** that has a first interior surface **44** shaped as desired for camming, and an inner ring **45** that has an outwardly facing surface **46** that is used as a control cam surface for some of the operations of the machine. The cam ring is stationary, while the shaft **19** is rotated by the motor **14**.

Referring to FIGS. **3** and **4**, the rotating assembly drum or turntable is shown. The turntable is operated in conjunction with stationary members such as the chutes **31** and **33**. In cross section, the drum or turntable is shown in FIG. **4**. This drum or turntable is illustrated generally at **50**. The turntable includes a support hub **51** that is drivably mounted onto the shaft **19** with a suitable pin **52**, or in other suitable manner. A thrust washer **53** is positioned between the lower end of the hub **51** and the upper end of bearing **21**. The drum assembly includes a lower or first plate **54**, an axial spacer **55**, and a top or upper plate **56**. These are all fastened together with suitable bolts and attached to the hub **51**. The spacer **55** rotates with the upper and lower plates, to form the drum assembly. In addition, a part support ring **57** is attached to and positioned below the lower plate **54** with suitable cap screws. The ring **57** extends outwardly to substantially align with the outer periphery of the lower plate. Therefore, the plate assembly comprises a rotating drum or turntable for the assembly operation.

The turntable is used for receiving the components to be assembled, and for carrying them around while the various operations are performed on these components in a continuous cycle. The shaft **19** also carries a plurality of cam operated plungers illustrated generally at **60**. As shown, in the present embodiment, there are eight of these individual plungers spaced evenly about the axis of rotation of the shaft **19**. Each of the plungers comprises a working station for the inspection and assembling operations. The plungers are operated by the cams **43** and **45**.

Referring to FIG. **4**, in particular, and also to FIG. **3**, a hub **61** is drivably mounted to the shaft **19** and mounts a support plate **62** fixed to the hub and extending outwardly therefrom. The plate **62** provides the mounting structure for the cam operated plungers. There are eight sleeves **63** attached to the plate **62** and spaced radially outward from the axis of shaft **19**. The sleeves **63** are spaced evenly annularly about the shaft **19**. Each of the sleeves **63** is used for slidably mounting a work plunger assembly illustrated generally at **65**. The plunger assemblies as shown include an outer plunger housing **66** that is slidably mounted in the sleeve **63** on suitable bushings, and which has a smaller diameter end portion **67** adjacent the lower end thereof. The individual plunger assemblies have small cylindrical plungers **70** slidably mounted in an interior chamber of the outer housing **66**, and the plungers **70** are spring loaded toward the end portions **67**. A small pin **71** operating a slot **72** is used for limiting the motion of the plungers **70**. A separate collar **73** is slidably mounted over each of the end portions **67** and is held in place with the pin **71** in the corresponding spring loaded plunger **70**. Each plunger **70** has a small finger or inspection probe **74** that normally protrudes through a provided opening in the end wall of end portion **67**, and is used, as will be explained, as an inspection finger and also for a lifting finger during operation of the machine.

The plungers **70** are loaded toward the end portions **67** with internal springs **75** mounted inside the housings **66**, and a connector **76** is threaded into the upper end of the housing **66**. The inner end of connector **76** bears against the corresponding spring **75**. A lock nut **77** also can be utilized on the connectors if desired. The connectors provide for adjustment of the plunger positions.

The housings **66** are thus mechanically connected to the connector **76**, and each of the housings is actuated for movement in sleeves **63** in axial direction, through the use of a separate bell crank assembly **80**.

The bell cranks **80** (there are eight of these bell cranks, one for each of the plungers) are used to operate the plungers for part assembly and inspection purposes. The bell cranks each include a first leg **81** and a second leg **82**. The bell cranks are pivotally mounted with pins **83** about an axis normal to the axis of shaft **19**. The leg **81** of each bell crank is loaded with a tension spring **84** that is attached in a provided manner to the corresponding finger **62**, and the spring is also attached with a pin **85** to the corresponding leg **81**. The connector **76** of each of the plungers is attached to the leg **81** of its corresponding bell crank with a chain link **86**, using suitable pins that permit the chain link **86** to pivot, as the bell crank pivots about its axis. The leg **81** moves up and down, and the small misalignment when the leg **81** moves up the down is compensated for by the link **86** so that the plunger is also moved up and down.

The leg **82** of each bell crank comprises a cam follower, and has a cam follower roller **89** thereon. The roller **89** is urged against the cam surface **44** by the spring **84**, and the plunger is normally held in position by this surface **44** against the action of the spring.

The bell crank is pivoted to, and the pin 83 is mounted in a bell crank support block 90, and the support blocks 90 are in turn attached to the plate 62 in a suitable manner. There are eight of these support blocks 90, one for each of the bell crank assemblies. The plunger housings 66, and the interior plungers 70, actuated by the bell cranks 80 are the working elements of the assembly process.

In order to position the parts to be assembled properly, the turntable plates 54 and 56 are utilized. When two parts are to be assembled, one of the plates is used for positioning and guiding each of the parts. As can be seen in FIG. 3, the plate 56 is provided with a plurality of piece part receptacles illustrated generally at 91 around the periphery thereof. As shown there are eight of these piece part receptacles, one corresponding to each of the plunger assemblies 65 and aligned with the plungers. The receptacles 91 have a gradual lead in surface 92, and a stop surface 93 as shown in FIG. 3. The receptacles 91 are designed to receive the part that is to be carried by these receptacles, and can be varied in size to suit the particular part being operated upon.

The lower plate 54 of the turntable is provided with a plurality of receptacles 94 shown in dotted lines in FIG. 3. The receptacles 94 also have tapered lead in surfaces, and a stop surface or part engaging surface made so that the part, in this instance a larger part than for receptacle 91, will be carried by the turntable and the receptacles thereon in direction that is indicated by the arrow 95, which is the direction of rotation of shaft 19, and the turntable assembly.

There is a stationary support shelf 100 that is mounted onto posts 35 with brackets 101 and 102 (see FIG. 3). This support shelf extends around the turntable from adjacent the track 31, which is the first loading station "A" for a first of the parts to be assembled. The shelf 100 receives and supports the parts 30 when they are moved from the chute 31. For example, referring to FIG. 4, the shelf 100 can be seen directly underneath the plunger and aligned with the receptacle 91 for the parts 30 coming off the chute 31. This particular part is just being loaded into the first station "A". It is to be remembered that the turntable continuously turns so that operations are being performed continuously as the units rotates. The stations can be considered to be the stationary positions around the periphery. However it is also to be remembered that each of the plungers is actuated exactly the same in one complete cycle or revolution of the turntable.

Assuming that the part 30 is positioned on the shelf or plate 100, as shown in FIG. 4, the moving receptacle 91 will engage this part and push it along as the part slides on the upper surface of the shelf 100 toward the chute 33 carrying the second parts 32. The second parts are moved onto the turntable at a position labeled as station B. A suitable guide member 103 is provided between station A positioned where the parts 30 are being loaded, and the station B position where the parts 32 are being loaded, to keep the part 30 in position in its corresponding receptacle as the part is moved toward station B.

In transit from station A to station B, the plunger assembly 65 actuated by bell crank 80 will be moved downwardly under the urging of the spring 84 because the cam surface 44 will permit the plunger to move downwardly. This will put the finger 74 onto the part 30 that has been deposited in the aligned receptacle 91 at station A, and if the hole illustrated at 30A of this part is present, the finger 74 will enter the hole. The parts 30 as shown are flexible polyethelene or other plastic so that there is a tight fit on this finger 74, and the finger will actually engage the part and hold it. The cam surface 44 is then designed so that when the plunger goes down, the finger 74 will enter the hole, if there is one, and then the plunger will be raised again so that the part will be carried by the finger 74 upwardly off the shelf 100 a very short distance. The actual lifting of the part 30 occurs so the insert 30 is lifted shortly after the corresponding plunger has passed station B.

Referring to FIG. 5, the plunger is shown at station B, as it would be with a hole 30A in the part. A part 30 is shown with finger 74 extending through the opening in the part 30. This means that the opening in part 30 is proper. The second parts 32 are coming along the chute 31, which is being vibrated, and as can be seen the part 32 is positioned in the receptacle 94. The parts 32 are supported by the peripheral ring 57 in the receptacles. This ring 57 rotates with the turntable assembly.

As shown, in FIG. 5 at station B, the upper part or insert 30 is supported on the upper surface of the shelf 100, and the lower part or cap 32 is positioned in the proper receptacle 94 to be carried along with the turntable assembly by the lower plate 54.

Shortly after the plungers pass station B, the cam surface 44 acts on the appropriate roller 89, actuating the bell crank 80 and lifting the plunger assembly 66 slightly to lift the part 30 off the surface of shelf 100, if the finger 74 has entered a hole in the part 30 as shown in FIG. 5. Now, referring to FIG. 6, the plunger has lifted as shown. If the finger 74 has found an opening in the insert 30, it is lifted off the surface of shelf 100 as shown in dotted lines. If, however, there is no hole 30A in the part or insert 30, or if the part 30 is defective in some other way so that it can't be lifted, the part will ride along the surface of the shelf 100 as shown in solid lines, and will drop down into a provided slot like recess 106, which is defined into the upper surface of the shelf 100. Referring to FIG. 3, it can be seen that this slot 106 extends outwardly at an angle beyond the periphery of the turntable assembly. Because the part is dropped down into this slot 106, the rejected part 30 will be pushed outwardly along this slot 106 by the movement of the turntable. The receptacle 91 will no longer hold the part. The rejected parts are pushed through an opening 107 into a reject receptacle.

Assuming that the part or insert 30 has been rejected, as the particular plunger and cam assembly continues to rotate with the turntable, the cam surface 44 then again permits the plunger assembly to move downwardly under the urging of spring 84, and if for example there was no hole in the part 30, there will be no part underneath the plunger (it will have been rejected). Then the cam permits the plunger assembly 65 to move to position as shown in FIGS. 7 and 8. In the solid line position of FIG. 8, it can be seen that there is no insert 30 underneath the plunger assembly 65, and the cam surface 44 permits the plunger assembly to move down very close to the shelf 100, and even a small groove can be provided in this plate for the finger 74. This permits the leg 81 of the cam to drop down sufficiently far to engage a switch actuator lever 110 that is mounted on a stud 111 that in turn is attached to plate 40. The end of leg 81 will align with and then engage the lever as the

turntable rotates if no part **30** is in place. The action of the cam surface **44** is sufficiently quick so that if there is no part **30** under a plunger assembly, the arm **81** will drop down in time to engage this lever **110** as the turntable rotates past the pivot of the lever **110.** This is shown in FIG. 7 where the lever **110** is also illustrated. As shown in FIG. **8,** the lever **110** aligns with the actuating finger **112** of a switch **113** that is also mounted onto a bracket **114** depending from the plate **40.**

Therefore, if there is no part **30** underneath the plunger moving past the lever **110,** from station B to station C, the lever **110** will be contacted by the end of the leg **81** of the corresponding bell crank. This will actuate the switch **113,** and the switch **113** in turn will energize a suitable solenoid operated control valve assembly **125** for doing two things. First, the valve actuates a pneumatic cylinder **117** under fluid pressure to extend the piston rod illustrated at **118.** This actuation in turn moves a pivot arm **119** that is pivotally mounted as at **120** to a frame block support **121** that in turn is mounted to the plate **12.** The pivot arm **119** carries a guide member **122** at its upper end which, in its normal position as shown in dotted lines in FIG. **8,** holds a part **32** in place on the support ring **57** as shown in dotted lines in FIG. **8.** As can be seen in FIG. **3,** if this plate **122** is in position, the part or cap **32** will be held in its particular pocket or receptacle **94** and carried past the guide member **122** from station C to station D. However, if there is no insert **30,** so that the switch **113** is energized, this guide **122** is moved to its solid line position as shown in FIG. **8.** The valve **125,** controlled by the switch **113** will also direct fluid under pressure from a source into a conduit **126.** The conduit **126** opens through a fitting **128,** which is spring loaded against the under surface of ring **57.** The fitting has a slot opening, which aligns with a passageway **131** in the plate at each of the receptacles **94** when the receptacles are in position as shown in FIG. **8.** The passageway **131** opens to a passageway **127** defined in the lower surface of the plate **54** aligned with each of the receptacles, and sealed off by the ring **57** so that fluid under pressure will pass into this passageway **127** through the fitting **128,** and will provide a jet of air to blow any cap member **32** in the receptacle **94** at station C out onto the top member **122** (which is retracted as shown) and then off into a reject receptacle **129.** The fitting **128,** as shown, is spring loaded with a spring **130,** up against the annular plate or peripheral plate **57** so that this will be in register with the passageway **131** entering the passageways **27** in this particular station C. The opening in fitting **128** leading to the passageway **131** is slotted as shown in FIG. **3** so the conduit **126** communicates with passageway **131** of each receptacle for a preselected number of degrees of rotation of the turntable. Then when the valve **125** is open a jet of air will blow the part **32** because there will be no insert for that part, and the part **32** will be rejected into the reject bin **129.**

Thus station C is a station to insure that there will be no parts or caps **32** without inserts that will go off the turntable as finished products.

Now, assuming that the insert **30** has an opening, and is present on the plunger **65** shown in FIG. **8,** the insert **30** would then lift the end of the plunger upwardly so that the leg **81** would reach its first dotted line position shown in FIG. **8,** and would clear the lever **110.** The lever **110** would not be actuated, the cylinder **117** and air jet would not be operated, and the part or insert **30** and the cap **32** would be carried past station C by the turntable. The insert **30** and the cap, assuming that they are both present, then move from station C to station D, and no rejection of the second part or cap **32** takes place.

It can be seen that the shelf **100** terminates adjacent station D. The part or insert **30** will be carried along the top of the shelf toward station D, and of course the cap member **32** will be carried as well. When the aligning receptacles holding both the insert and cap approaches station D, and after the shelf **100** terminates, the cam inner surface **46** on the inner cam **45** will engage the roller **44,** and will force the bell crank to move so that the arm **81** moves downwardly to push the corresponding plunger down. When the shelf **100** is no longer present, the plunger will be moved to position as shown in FIG. **9** as it travels to station E so that the insert is actually forced down by the plunger into the interior of the cap or part **32,** the insert is held in this cap by a small finger **32A** that fits into opening **30A.** When the cap and insert assembly are placed onto a filled juice container, the insert **30** will fit into the interior of the neck of the opening and the screw cap **32** can be removed and replaced. The cap and insert are thus a subassembly as shown.

The surface **46** acts to force the cam surface **89** to move the bell crank **81** downwardly and press the two parts together as shown. At the same time, the collar member **73,** which is of larger size than the receptacle **91,** engages the upper surface of the plate **56,** and then in the final movement of the bell crank, the collar **73** is pushed upwardly against this action of the interior spring **75,** and the plunger **70** and pin **71** slides in slot **72** so that the finger **74** is mechanically retracted from the hole **30A,** and the part or insert is thus released from the plunger. The end of the plunger assembly holds the insert down while the finger **74** retracts.

As a plunger moves from station E to station F (refer again to FIG. **3**), the plunger remains in its down position as shown in FIG. **9,** and a finger **135** of a counter **136** engages the outer periphery of the cap **32** to count the number of assembled units. It should be remembered now that if there is no insert, or if the insert has been rejected by slot **106** the counter would not be actuated. Also, if there is no cap **32,** but there has been an insert carried around, the insert would be carried by the plunger finger **74** and moved downwardly as shown in FIG. **9.** The insert would be deposited on ring **57** and held there by the plunger as the plunger moved past station F. However, the counter finger **135** is positioned so that the smaller diameter insert **30** will not actuate the counter. It should also be noted that if there is no outer cap **32,** the finger **74** will be withdrawn from the insert **30,** but the plunger will continue to hold the insert as the unit moves from station E to station F.

Then, as the turntable continues to move so that a particular plunger assembly reaches Station G, the plungers are raised to their highest position, completely removed from the receptacles as shown in FIG. **4** and held in this position by the surface **44.** At station G, a stripper guide **137** which extends inwardly into an annular recess **138** formed in plate **54** inwardly from the receptacles **94** engages the parts, and the outer edge surface **137A** of this stripper guide **137** will force the parts outwardly as the turntable continues to rotate, the guide strips the parts out of the turntable or drum assembly. Again, if there is only an insert **30** in the recep-

tacle moving past station G it would also be stripped out by the stripper guide **137**.

The stripper deposits the cap assemblies, or if only an insert, also the insert onto a final sorting device **140**. The sorting device **140** comprises a sorter **141** having an inclined surface onto which the parts are deposited as the drum rotates. The surface of sorter **141** inclines toward a sorting bar **142** mounted on sorter **141**. The sorting bar is spaced upwardly from the surface of the sorter **141** a sufficient distance, so that if only an insert part **30** is present, it will pass underneath the sorting bar **142**, and will fall into a reject receptacle provided. If, however, there is a properly assembled cap, the edge of the cap **32**, which is longer than the insert, will engage the edge of the sorting bar **142** and will move downwardly along the bar in direction as indicated by the arrow **143** into an accept bin for use and assembly. As the turntable continues to rotate, then the receptacles all move back to station A and the process continuously repeats. The stripper **137** will remove any parts in the receptacles of the drum assembly.

Thus there is a two part assembly, and inspection procedures provided on a continuous basis. The unit can rotate about the axis of the shaft quite rapidly because there isn't any reciprocating motion other than the very smooth action of the cam and plungers, and up to 16,000 parts per hour can be assembled and inspected by this device. If the insert does not have the opening as shown, it will be rejected, and if there is no insert, the outer part will be rejected. The ability to inspect for presence of parts is utilizable with assemblies of many different nesting parts.

The inspection can be for size, shape, presence of holes or other features than can be inspected by plungers using sizing fingers, or collets. For example, a collet that checked a part for a particular shape could be used. Also, if desired, a check of size and shape of the second part can be made, for example between stations D and E. Then, if the second part **32** was not of proper size, shape or configuration, it could be rejected before assembly. As can be seen, the stripper could be moved around the periphery to accommodate one more inspection and rejection station.

The chutes **31** and **33** incline downwardly as shown in FIG. **2**, thereby urging the end parts toward the periphery of the turntable under gravity. The part chutes are also vibrated so the parts slide down the chutes easily. The receptacles pick up the parts one at a time and carry the parts around for assembly. If desired, detectors can be used for detecting when there are no parts being supplied to the turntable. Then suitable warning signals or shut off interlocks can be used.

The controls are simple, and operation is primarily mechanical. The double cam surface permits inspection of parts and general operation to be performed under spring force (springs **84**) but the cams also positively force the assembly together.

What is claimed is:

1. A continuous motion two part assembly machine comprising a frame, a turntable rotatably mounted about an axis with respect to said frame and rotating in a cycle of operation, a plurality of actuable means mounted for movement with said turntable, means to supply a first of said parts to be assembled, means to supply a second of said parts to be assembled, said means to supply said first part to be assembled depositing said first part in position to be moved by movement of said turntable in its cycle of operation, and said means to supply said second of said parts depositing said second parts in position to be moved with the turntable and aligned with a first of said parts along a line of operation of said actuable means, said actuable means including means to inspect one of said parts, means to reject said inspected part if said inspected part is not acceptable, and means to operate said actuable means to move aligning first parts and second parts into assembly subsequent to the means to reject in the cycle of operation of said turntable, whereby assembly of the parts will occur only if the inspected part has not been rejected.

2. The combination as specified in claim **1** wherein said first part is deposited on a stationary shelf member, and means on said turntable to engage and move said first parts along said shelf member as said turntable rotates.

3. The combination as specified in claim **2** and support means positioned for movement with said turntable for supporting said second parts.

4. The combination as specified in claim **3** wherein said means to move said first and second parts with said turntable comprise recesses formed in the peripheral edges of said turntable, said recesses being of size to receive the respective parts and having central portions aligned with each other in direction of movement of said actuable means, said shelf member extending inwardly from the outer periphery of said turntable to effectively divide the recesses for the first part from the aligned recess for the second part during a preselected portion of each rotational cycle of said turntable.

5. The combination as specified in claim **4** wherein the shelf member supporting said first part terminates adjacent the position where said actuable means move the parts into assembly, and said assembled first and second parts thereafter being supported on said support means.

6. The combination as specified in claim **2** wherein said means to inspect one of said parts, comprises means to move one of said actuable means into engagement with a first part, means to releasably retain an acceptable first part on said actuable means, and means to move said actuable means in direction to lift acceptable first parts off said shelf member during a preselected amount of rotation of said turntable.

7. The combination of claim **6** further characterized in that said means to reject said first part comprises means to remove from said turntable a first part resting on said shelf member and being moved therealong by said turntable during said preselected amount of rotation thereof.

8. The combination as specified in claim **1** and means operating said actuable means comprising a stationary cam, and cam followers on said actuable means engaging said cam as said turntable rotates.

9. The combination as specified in claim **1** wherein said turntable has a thickness in axial direction, and means to retain said first parts adjacent a first side of said turntable when said means to inspect and reject are operating, and means to retain said second parts adjacent a second side of said turntable and aligned in axial direction with said first parts.

10. A two part assembly machine comprising a frame, a rotating turntable rotatably mounted with respect to said frame about a substantially upright axis, a first shelf mounted on said frame adjacent the periph-

ery of said turntable and extending therearound for a preselected distance, said shelf being stationary with respect to said turntable and being positioned below at least a peripheral portion of said turntable, a plurality of annularly spaced pockect means formed in said peripheral portion of said turntable above said shelf and open to the peripheral edge of said turntable, means to deliver a first article to be assembled onto said shelf, said first articles being urged toward the axis of said turntable whereby each pocket means picks up one of said first articles as the turntable rotates and moves said first articles along said shelf, means to deliver a second article to said turntable below said shelf, said turntable having a second article support carried thereby on which said second articles are supported, means to inspect said first articles, means to reject defective first articles in response to said means to inspect, means operable by said turntable subsequent to rotation thereof past the means to reject and responsive to absence of a first article to cause rejection of second articles at a corresponding pocket means on said turntable, and assembly means to move acceptable first articles toward the second article support for assembly with a second article after the turntable has moved past the means causing rejection of said second articles in absence of said first articles, and means to remove and sort parts from said turntable subsequent to rotation past the assembly means whereby any first articles not assembled in second articles will be rejected, and assembled articles including said second article will be accepted.

11. The combination as specified in claim **10** and separate plunger means mounted on said turntable adjacent each pocket means and movable substantially in axial direction of the axis of rotation of said turntable, said plunger means forming a portion of the means to inspect and engaging accepted first articles thereon, said plunger means comprising said means to move said first articles toward the second articles to assemble said first articles into said second articles rotationally subsequent to the position wherein said second articles are removed responsive to absence of said first articles.

12. The combination as specified in claim **11** wherein said means to reject said second articles comprises an air jet means directed toward the second article support on said turntable, and means to energize said air jet means comprising a switch, means to actuate said switch in response to position of said plungers, said plungers being moved to clear said last mentioned means when a first part is engaged by said plungers.

13. The combination as specified in said claim **10** wherein said means to inspect said first articles comprises a plunger member associated with each turntable pocket means and engagable with each first article in its corresponding pocket means and including means to removably connect the first article to said plunger member when said first article has a preselected configuration, means operating said plunger member to subsequently lift said plunger member and said first article with said preselected configuration, said means to reject said first articles being rendered ineffective in relation to first articles lifted by said plunger member.

14. The combination as specified in claim **13** wherein said means to reject said first articles comprises means to cam articles resting on said shelf away from said turntable subsequent to the insepection of said first articles, said means to cam being positioned in location to be effective prior to the time when the turntable has moved to position to cause actuation of the second article rejection means.

15. The combination as specified in claim **13** wherein said preselected configuration comprises the presence of a hole in said first article, and said plunger member comprises a finger of size to fit within said hole, the material of said first article being resilient and the hole being of size to grip said finger.

16. The combination as specified in said claim **13** wherein said plunger member carries said first article until said turntable has rotated past the means to cause rejection of said second part, and means to retract said finger from said first article.

17. The combination as specified in claim **13** wherein said plunger members are actuated by cam means, said cam means being mounted on said frame stationary with respect to said turntable, and cam roller means engaging said cam means as said turntable rotates, said cam roller means being connected to actuate said plunger members.

18. The combination as specified in claim **11** and second pocket means formed in said turntable and open to the periphery thereof, said second pocket means being of size to receive and guide second articles supported on said support member, said first article pocket means and said second pocket means being aligned, and spaced in axial direction of the turntable to a sufficient distance to permit said shelf to separate said pocket means for a preselected portion of travel of said turntable.

19. The combination as specified in claim **11,** and and counting means mounted on said frame engagable only by second parts on said turntable as said turntable rotates, said counting means being positioned subsequent to said assembly means in a rotational cycle of said turntable.

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