(12) UK Patent Application (19) GB (11) 2 100 174 A

(21) Application No **8127490**
(22) Date of filing **23 Apr 1979**
Date lodged **11 Sep 1981**
(30) Priority data
(31) **53/048573**
53/048575
53/054350
(32) **24 Apr 1978**
24 Apr 1978
24 Apr 1978
(33) **Japan (JP)**
(43) Application published
22 Dec 1982
(51) **INT CL³**
B29C 17/12 7/00 17/07
B29F 1/14
(52) Domestic classification
B5A 1AX 1R314C1X
1R314C6 1R420 20T14
20T15 20T20 2A3 2B1
2B2 2D2 2E3 2H5 2V
D37T
(56) Documents cited
GB 1410093
GB 0868888
(58) Field of search
B5A
(60) Derived from Application
No. 7914131 under
Section 15(4) of the
Patents Act 1977
(71) Applicants
Yoshino Kogyosho Co Ltd,
No. 2—6 Ojima 3-chome,
Koto-ku, Japan
(72) Inventors
Tsugio Nomoto,
Yoshiyuki Ichizawa,
Mamoru Oshida
(74) Agents
Bromhead and Co,
30 Cursitor Street,
Chancery Lane, London
EC4A 1LT

(54) Gate cutting apparatus for injection moulded parisons

(57) Gate cutting apparatus for cutting the gates from injection-moulded tubular parisons comprising a plurality of holders (71) supported on vertical chains (91) for receiving parisons in the same array as they were in at the time of injection moulding (e.g. four by four), the chains (91) being moveable intermittently to bring the parisons to a cutting position (74) (four at a time as shown in figure 10), and gate cutting means having holders (111) (figure 15) which hold parisons in such a manner that their gates project from the holders (111), and cutters (110) which are moveable transversely to cut off the gates.

FIG.10

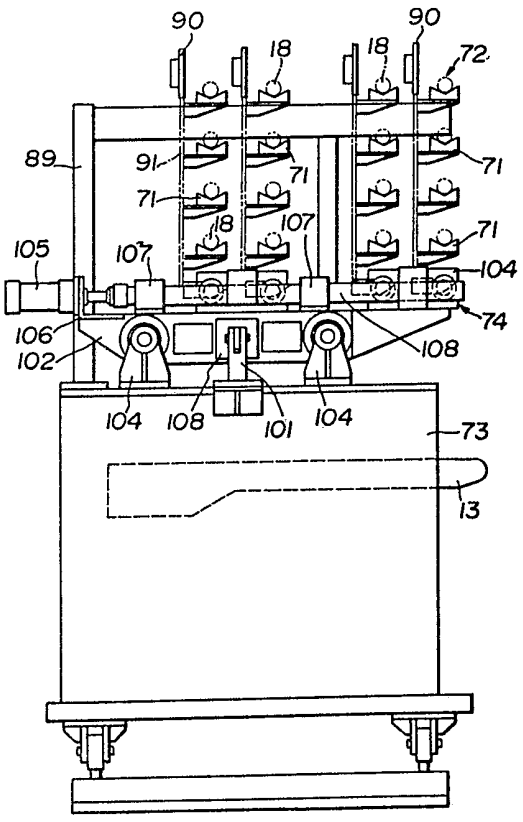
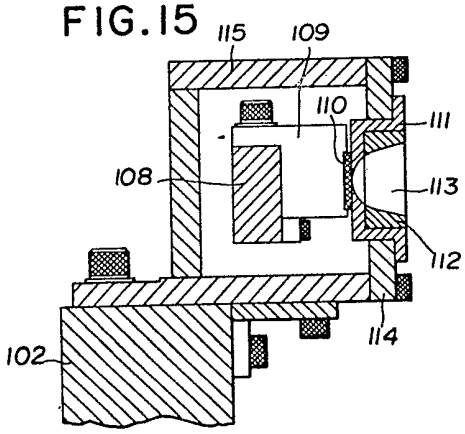


FIG.15



GB 2 100 174 A

2100174

FIG.1

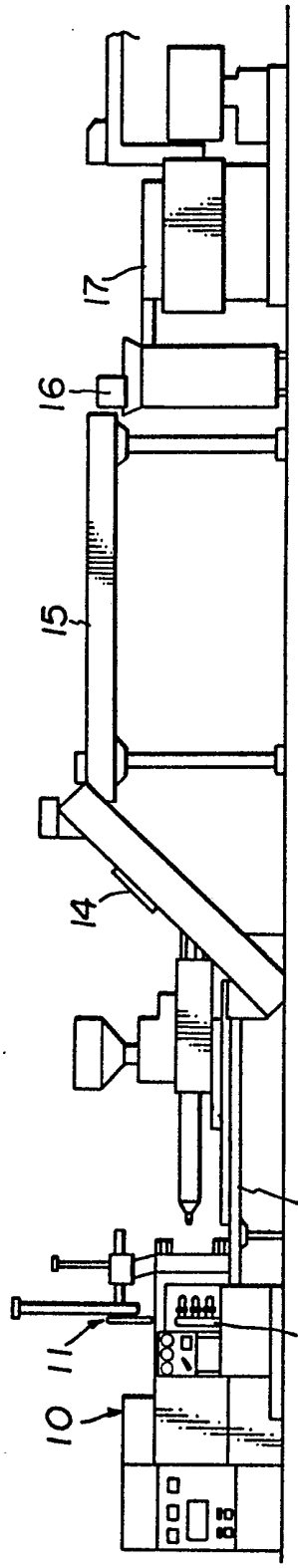
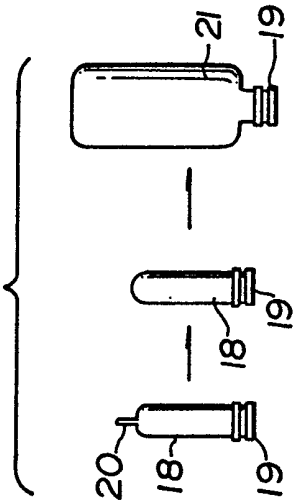
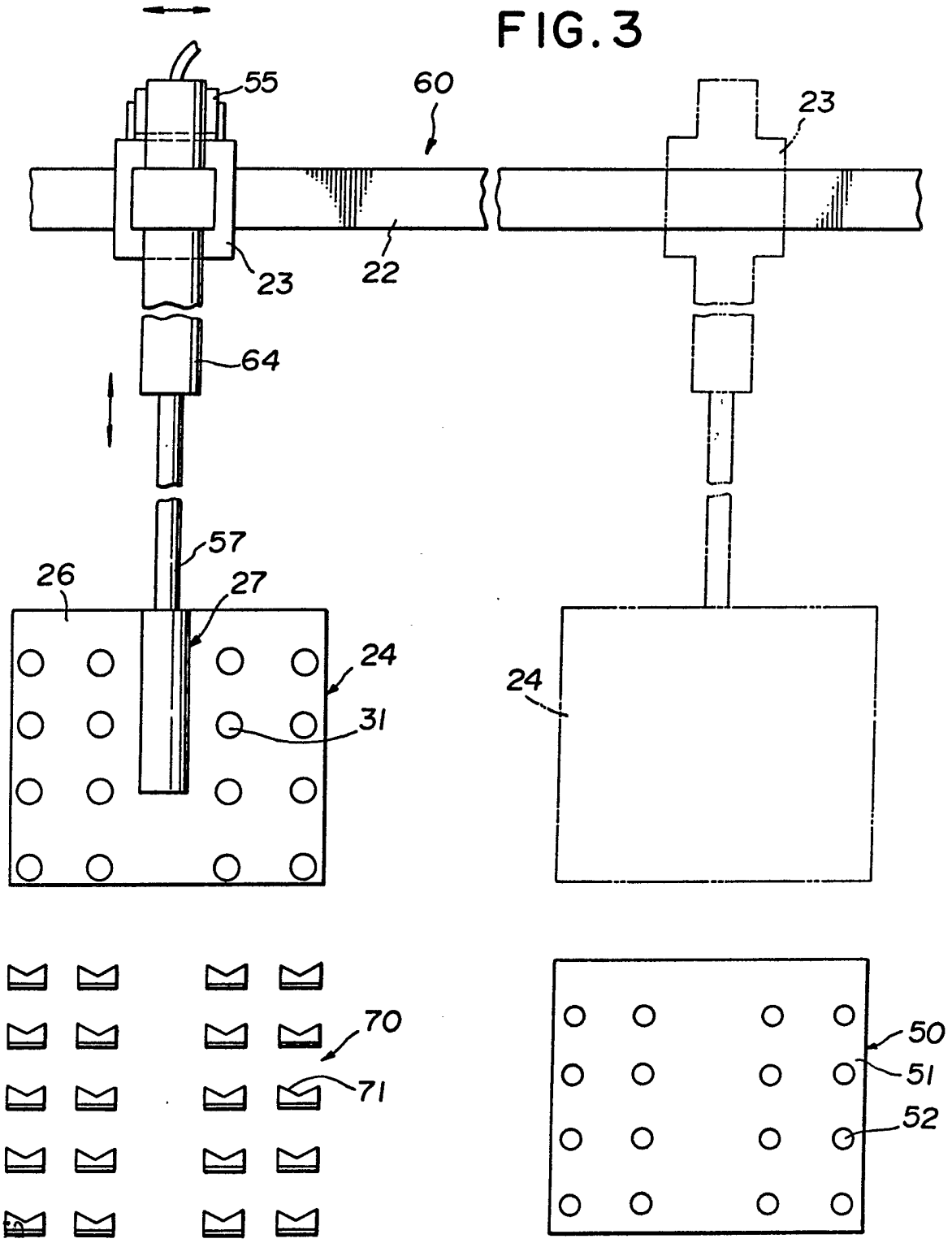


FIG.2



2100174

FIG. 3



2100174

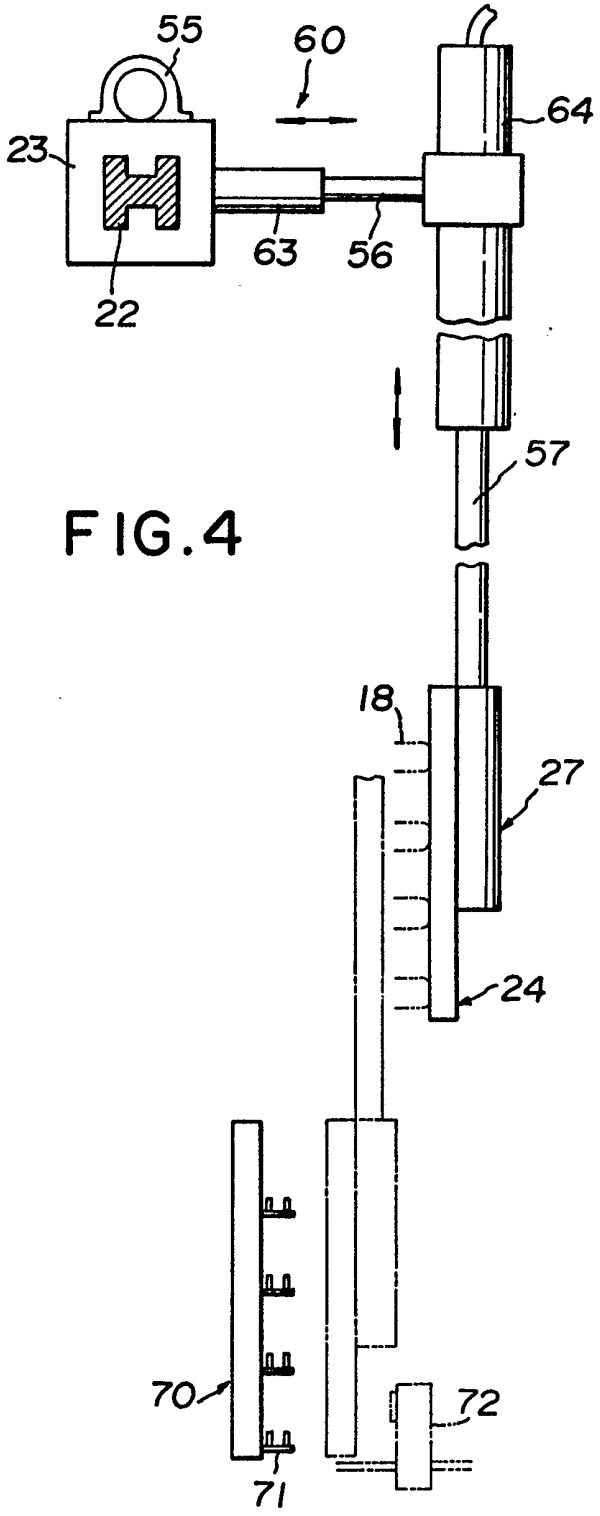


FIG.4

2100174

FIG.6

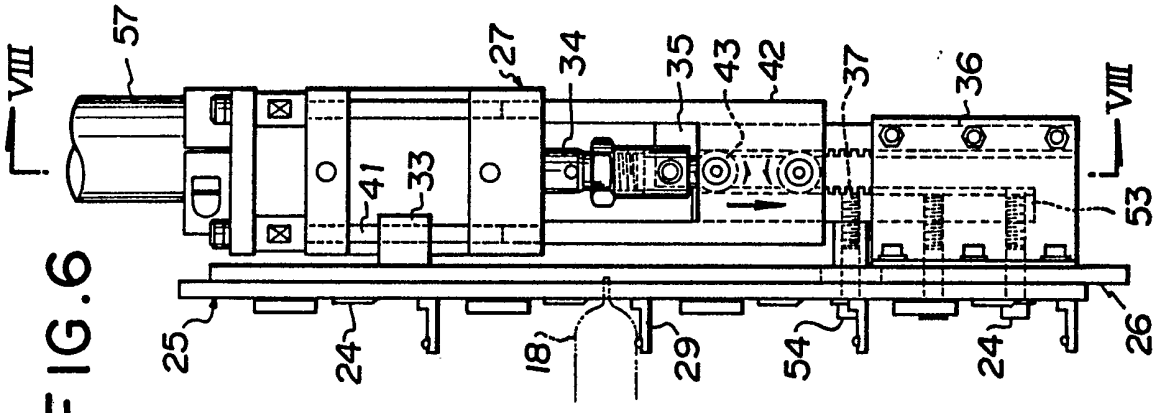
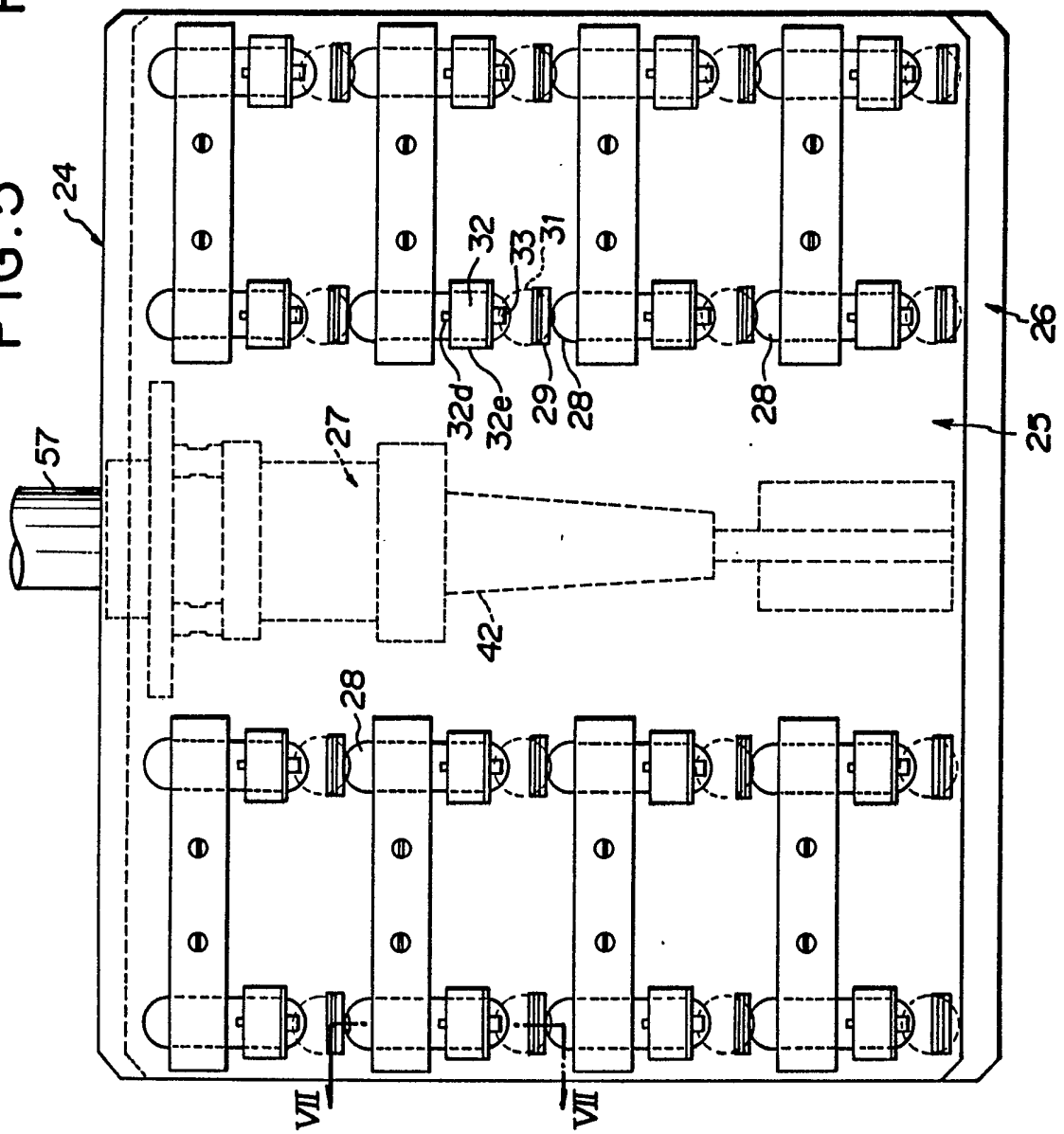


FIG.5



2100174

FIG.7

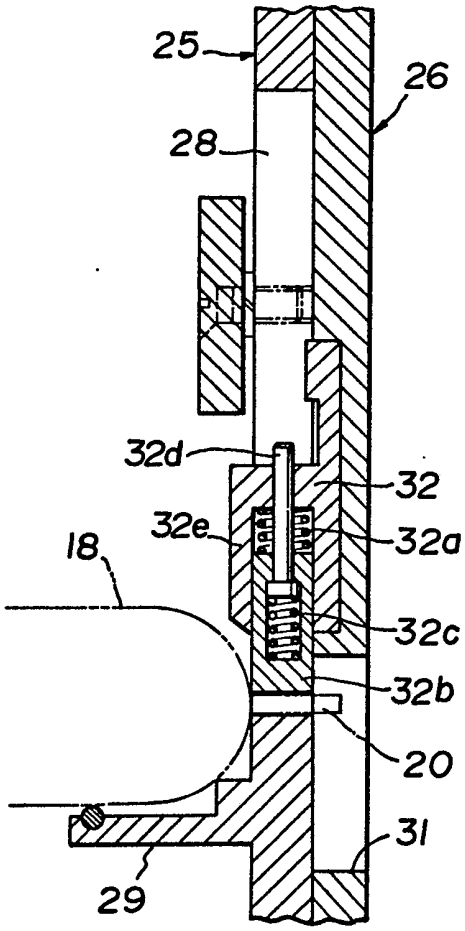
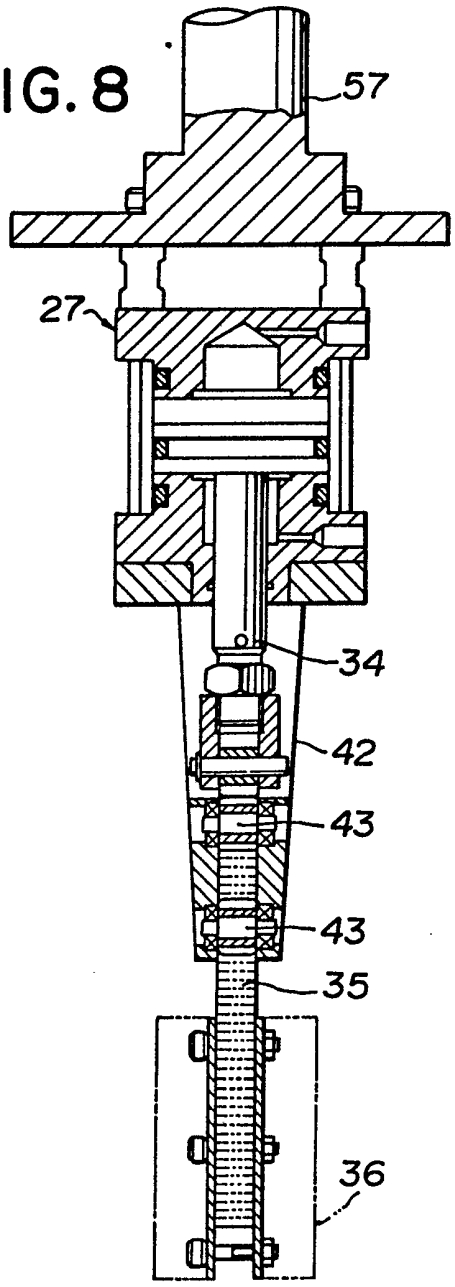
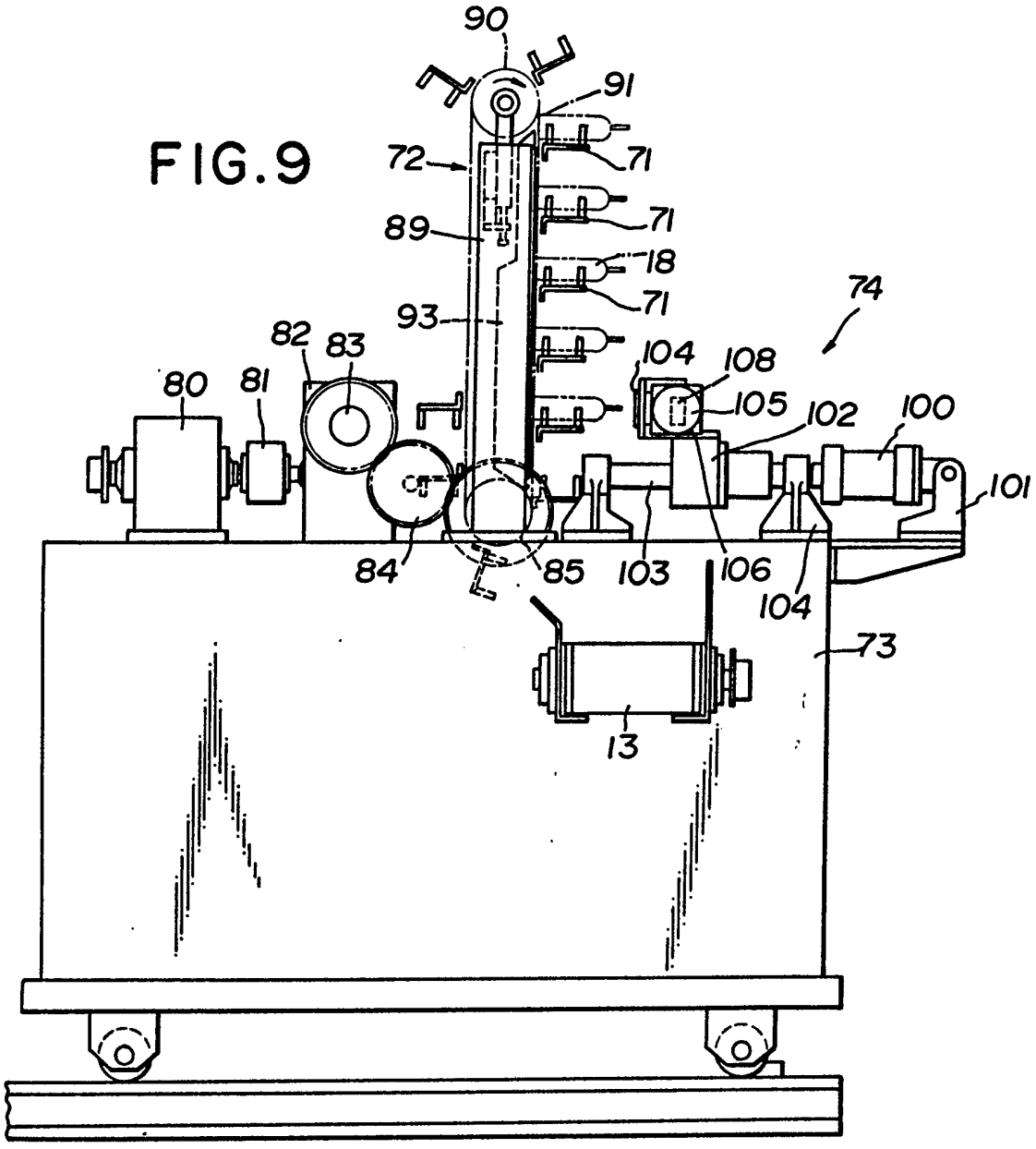


FIG.8



2100174

FIG.9



2100174

FIG.10

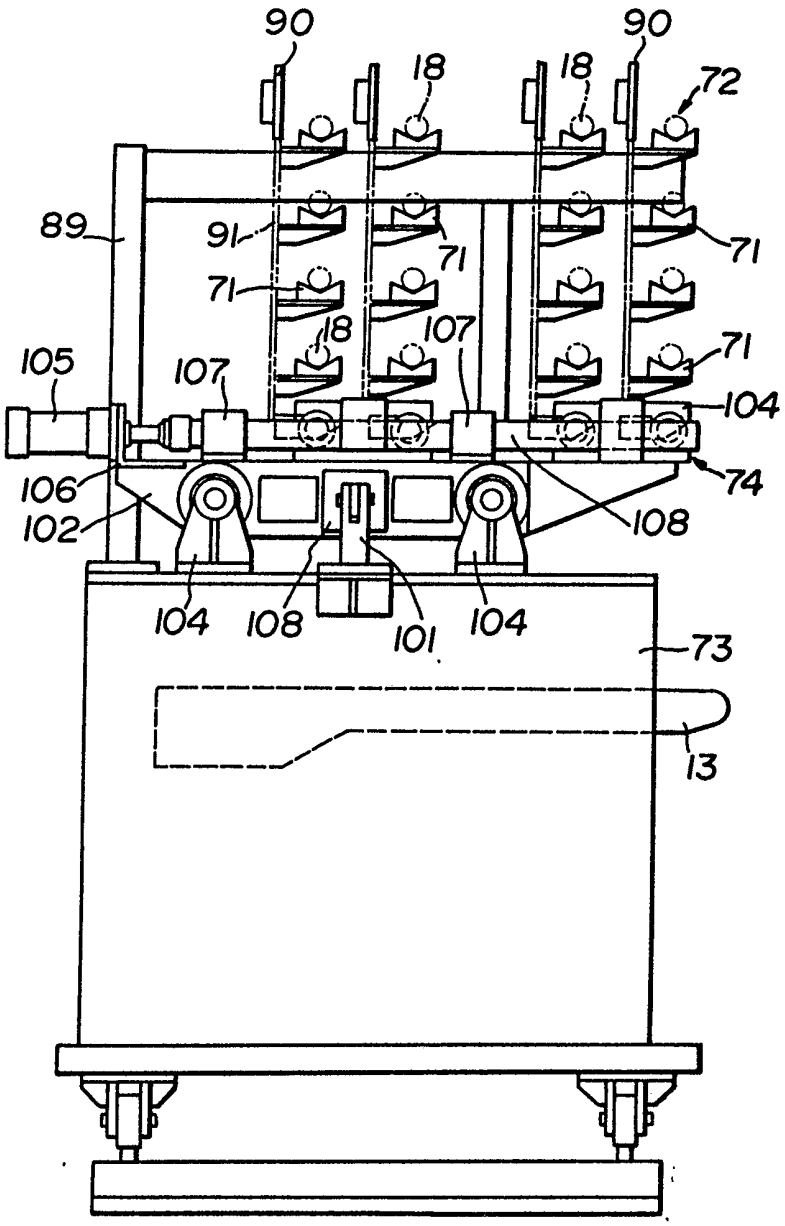
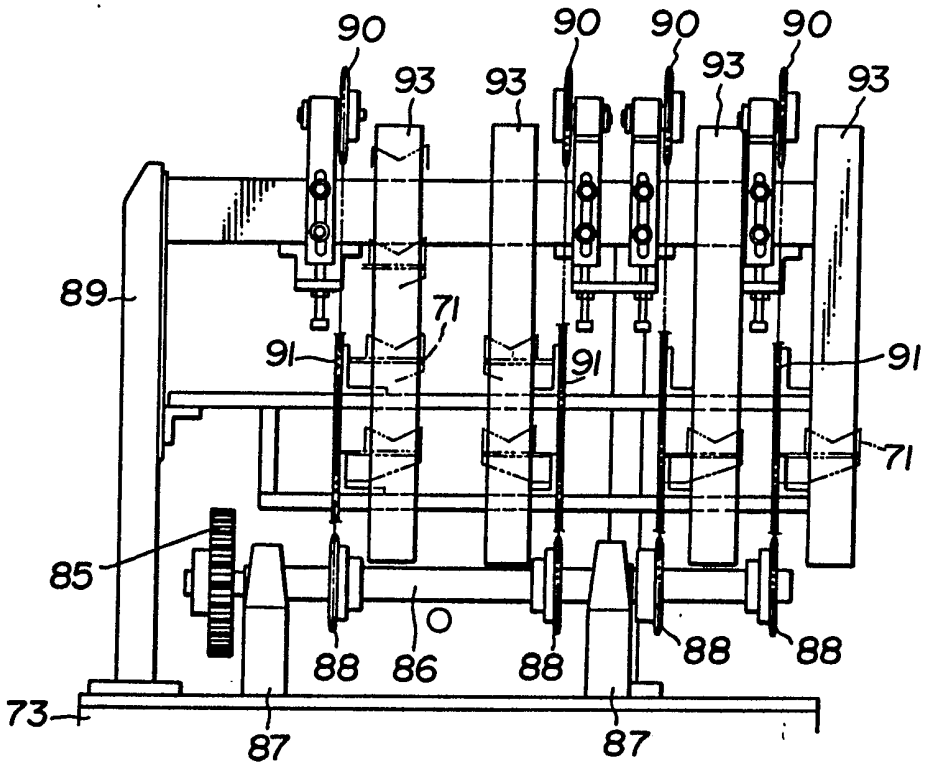


FIG.11



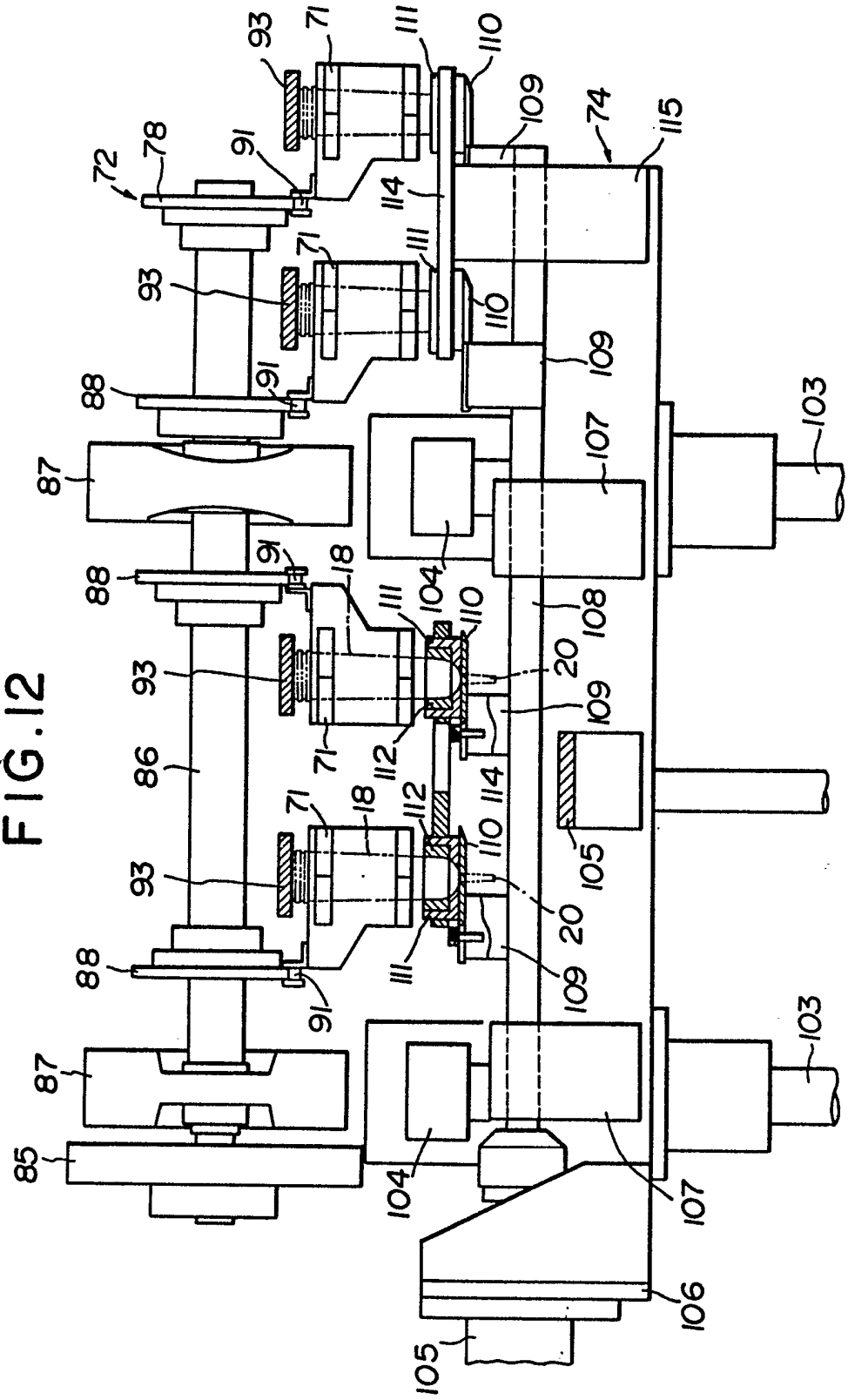

93
71
111
110
109
74
115
72
78
91
114
88
87
107
103
18
104
108
20
86
112
105
85
106

FIG. 12

2103174

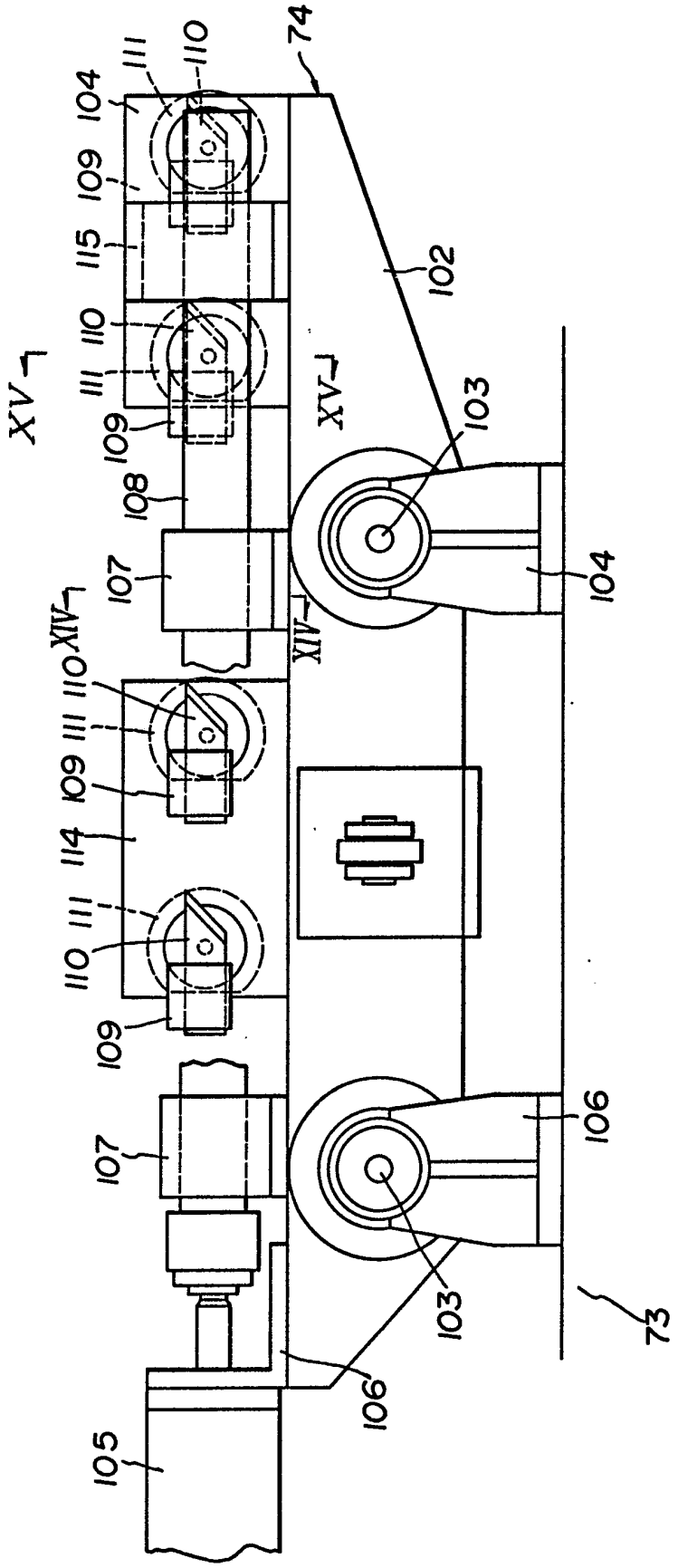


FIG. 13

2100174

FIG. 14

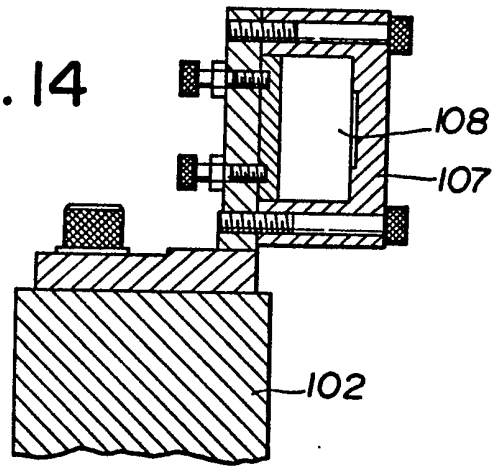
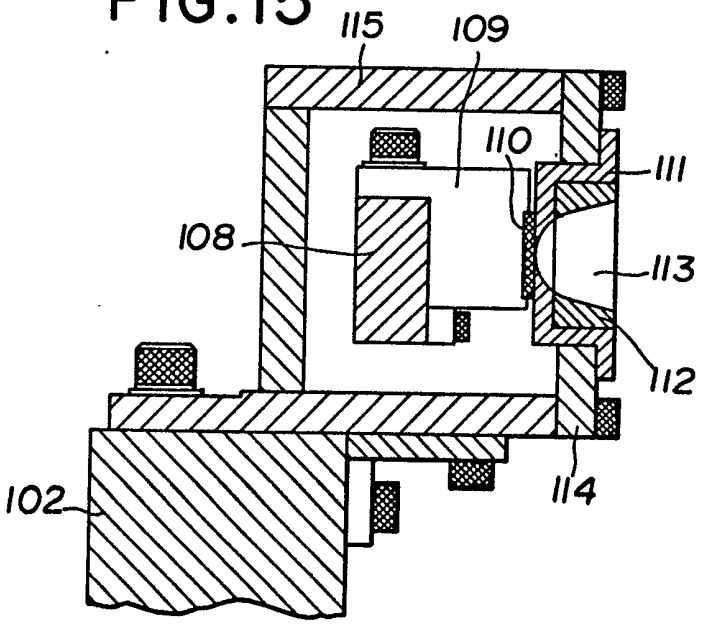


FIG. 15



2100174

FIG. 16

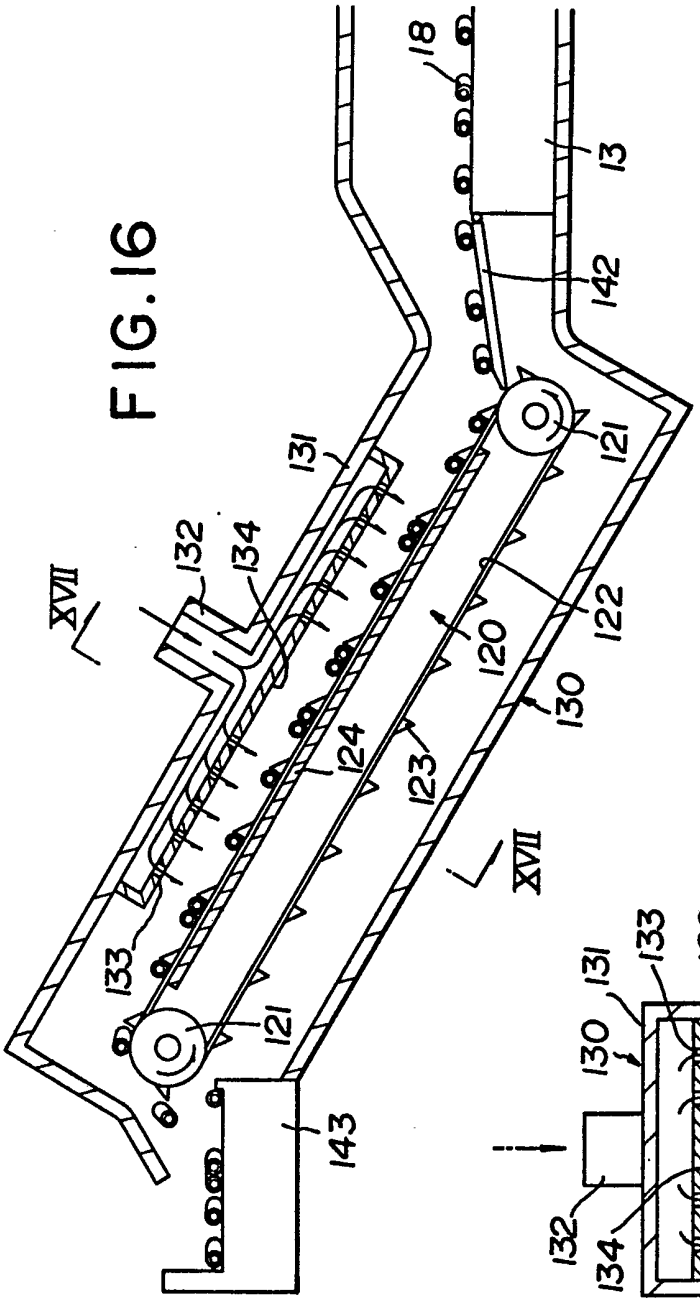
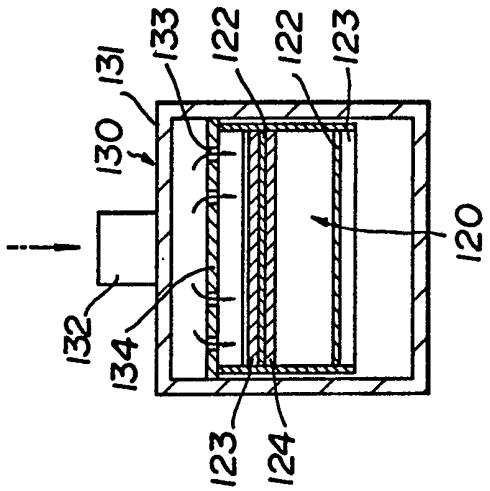


FIG. 17



SPECIFICATION

Gate cutting apparatus

The present invention relates to gate cutting apparatus which may be included in equipment for transferring injection-moulded piece in a process line for fabricating polyethylene terepthalate bottle-shaped blow-moulded containers from an injection moulding machine to a biaxially orientation blow moulding machine, more especially in equipment which performs the steps of drawing or removing a preformed piece from the mould core of an injection moulding machine, cutting the gates from the pieces, and temporarily cooling the pieces to accurately obtain the desired moulding conditions before heating them to a temperature adapted for a biaxially orientation process.

Polyethylene terephthalate resin has a wide range of applications in the field of moulding material of synthetic resin bottle-shaped containers because of its superior physical properties and characteristics.

In moulding a bottle-shaped container of polyethlene terephthalate resin, there may be adopted a so-called injection blow moulding process in which a preformed piece of cylindrical shape with a closed bottom end is injection-moulded, and is then biaxially oriented blow-moulded making use of its preferable characteristics.

Therefore, such a bottle-shaped container is moulded by a process having, in sequence, the steps of injection moulding the piece, removing the piece thus injection-moulded, and clamping the piece in a blow moulding machine for blow moulding the same.

It is desirable to automate these steps to complete the moulding process of such a bottle-shaped container. However, considerably thick gates are formed integrally with the pieces thus injection moulded owing to polyethylene terephthalate characteristics, and these gates have hitherto been manually removed with a cutter designed for that purpose one by one.

However, since the injection moulding process generally takes longer than the blow moulding process, and the injection moulded piece is relatively small, a number of such pieces are usually produced in one moulding process. Accordingly, it takes a relatively long time to completely fabricate bottle-shaped containers when numerous pieces thus injection-moulded have to have their gates removed manually one by one resulting in remarkably inefficient productivity.

It is an aim of the present invention to overcome this problem. Accordingly, the present invention is directed to gate cutting apparatus for receiving pieces from an injection moulding machine horizontally in the same array as they were in at the time of the injection moulding, intermittently conveying the pieces, and sequentially cutting the gates from the pieces, comprising:

(a) piece conveying means including a number of piece holders supported on vertical chains to be intermittently moved at predetermined moving intervals for horizontally holding the pieces at positions which are spaced apart by a distance equal to that by which the piece conveying means move the pieces at each intermittent movement, and a stopper plate or plates disposed at the back of the piece holders for restricting backward movement of each piece held by a piece holder at least when disposed at a cutting position for cutting the gate from the piece; and

(b) gate cutting means including piece end holders each of which has a piece end receiving recess for receiving an end of a piece disposed at the cutting position and which is mounted for movement forwards and backwards towards and away from the pieces held by the piece holders at the cutting position, and a cutter for cutting the gate which projects from the piece end holder, the cutter being mounted so that it is movable in a direction perpendicular to the axes of the pieces held by the piece holders so that it can perform this cutting operation.

Such apparatus may be included in equipment which is constructed to remove and convey injection-moulded piece in a process line for fabricating a bottle-shaped blow-moulded container, having a piece removing unit for holding the gates of numerous cylindrical pieces moulded by sequential injection moulding steps of an injection moulding machine and moving them aside from the machine, a gate cutting unit for cutting off the gates of the pieces thus removed, and a cooler for cooling the pieces to room or less than room temperature as predetermined.

The gate cutting apparatus may be constructed to simultaneously remove the pieces, without scratching them, from the moulds of the injection moulding machine.

The injection-moulded pieces may be cooled to a predetermined temperature while being conveyed in order to make the heating conditions of the pieces, immediately before the biaxially orientation blow moulding process, uniform.

A biaxial orientation blow moulding process line incorporating an example of apparatus in accordance with the present invention is illustrated in the accompanying drawings, in which:—

Figure 1 is a side view of the process line;

Figure 2 is a view showing the moulding sequence of the pieces in the process line;

Figure 3 is a partial front view of a unit for removing the pieces from an injection moulding machine of the process line;

Figure 4 is a side view of the unit shown in Figure 3;

Figure 5 is an expanded front view of a base plate of the injection-moulded piece removing unit;

Figure 6 is a side view of the base plate shown in Figure 5;

Figure 7 is a sectional view of the base plate taken along the line VII—VII of Figure 5;

Figure 8 is a sectional view of the base plate

taken along the line VIII—VIII of Figure 6;

Figure 9 is a side view of a gate cutting unit of the process line;

Figure 10 is a front view of the gate cutting unit shown in Figure 9;

Figure 11 is a front view of an intermittently-lowering mechanism for use with the gate cutting unit;

Figure 12 is an enlarged plan view of a cutting part of the gate cutting unit;

Figure 13 is an enlarged front view of the cutting part shown in Figure 12;

Figure 14 is a sectional view of the cutting part taken along the line XIV—XIV of Figure 13;

Figure 15 is a sectional view of the cutting part taken along the line XV—XV of Figure 13;

Figure 16 is a longitudinal side sectional view of a cooler of the process line; and

Figure 17 is a sectional view of the cooler taken along the line XVII—XVII of Figure 16.

Referring particularly to Figure 1, an injection moulding machine 10 has an injection-moulded piece removing unit 11, and a gate cutting unit 12 provided adjacent to the piece removing unit 11. A belt conveyor 13 and a cooler 14 follow the gate cutting unit 12. After the cooler 14 are sequentially arranged a conveyor 15, an aligning unit 16, and an orientation blow moulding machine 17 including a heater (not shown).

The injection moulding machine 10 moulds numerous cylindrical pieces 18 each with a bottom. As shown in Figure 2, each of the pieces 18 has a prefinished neck portion 19 at the opening side thereof, and a gate 20 projecting integrally from the centre of the bottom thereof. The gate of each piece 18 is cut from the piece 18 by the gate cutting unit 12. Each piece 18 is then fed through the sequential units described above, then to a jig, heated by the heater (not shown) while being supported by the jig, then oriented longitudinally in the orientation blow moulding machine 17, further oriented laterally in the moulding machine 17, and fully moulded into a bottle-shaped container 21 being a biaxial orientation blow-moulded plastics container as shown at the extreme right in Figure 2.

Each of the units in the piece moulding process line will now be described in detail.

The Piece Removing Unit 11

Figures 3 to 8 show the detailed construction of the piece removing unit 11. It has a rail 22 fixedly installed perpendicularly over a mould 50 in the injection moulding machine 10, moving means 23 laterally movable to the left or right along the rail 11, and a base plate 24 elevationally movably hung from the moving means 23 integrally with a holding mechanism (not shown).

The base plate 24 is constructed to make a flat front plate 25 contact with a flat rear plate 26 in relatively slidable manner upon telescopic movements of a hydraulic cylinder 27 having a piston rod 57. In this way the base plate 24 can thus hold or release the piece 18 to be moulded to a bottle-shaped container of polyethylene terephthalate resin at its gate 20 which projects from the centre of the bottom of the piece 18, as shown in Figure 6.

The front plate 25 is disposed to face a male mould 51 (shown in Figure 3) opened at the front surface in the injection moulding machine 11 and is constructed with a number of longitudinal elongate holes 28 which perforate the plate 25 and are arranged in the same manner and number as those of a number of cores 52 projecting from the mould 51 (shown in Figure 3). Each of the holes 28 has a predetermined length of the extent capable of receiving the gate 20 of the piece 18 at the bottom thereof. A number of supporting projections 29 protrude from the front surface of the front plate 25 directly under the respective holes 28 to enable the pieces 18 to be carried when the gates 20 enter the holes 28. Thus, each of the projections 29 protrude at a position which is lower than the bottom of each of the holes 28 by an amount which is substantially equal to the radius of the piece 18.

In a preferred arrangement shown in Figure 7, the rear plate 26 is disposed to make slidable contact with the front plate 25 at the back surface thereof. It is constructed with a number of spill holes 31 at the lower portions of the holes 28 respectively of the front plate 25 in such a manner that each of the gates 20 of the pieces 18 do not collide at the top thereof with the rear plate 26 when the gate enters its associated hole 28 so that each of the gates 20 may completely enter its associated hole 28 of the front plate 25.

A holder 32 is provided by the upper region of each hole 31 to be slidable in the hole 28 of the front plate 25. The holder 32 makes slidable surface contacts at its front and rear surfaces with the inside surfaces of the front and rear plates 25 and 26 respectively, the holder 32 making a tight fit with the front and rear plates 25 and 26.

As also shown in Figure 7, the holder 32 has a compression spring 32*a* fitted therein, a gate holding piece 32*b* telescopically slidably inserted thereinto, a balance spring 32*c* fitted in the gate holding piece 32*b*, a guide pin 32*d* slidably extending through the holder 32 and also, in part, through the gate holding piece 32*b*, and a guide cylinder 32*e* for guiding the gate holding piece 32*b* slidably.

Referring back to Figures 3 and 4, a hydraulic cylinder 27 is elevationally telescopically secured to the rear plate 26 *via* a bracket 33 fixedly secured to the back surface of the plate 26 at an upper region thereof in a manner which in slidable at a piston rod 34.

In Figure 6, which shows the detailed relationship between the rear plate 26 and the cylinder 27, a vertical pin 41 is secured to the side of the cylinder 27 and is journaled with the bracket 33 in slidable manner in such a manner that the cylinder 27 is relatively elevationally movable with respect to the rear plate 26. Further, referring to Figure 8, a frame 42 is suspended from the bottom of the cylinder 27 and is constructed to mount a pinion 43 at the lower

portion therein. A rack 35 staying in mesh with the pinion 43 is connected to the lower end of the piston rod 34 telescoped with the cylinder 27, and is also secured at the lower end thereof through a bracket 36 to the back surface of the rear plate 26 at a lower region thereof. Thus, as the rear plate 26, bracket 33, piston rod 34, rack 35, and bracket 36 are integrally assembled via pins or the like, the rear plate 26 can be elevationally moved with respect to the cylinder 27 upon telescopic movements of the cylinder 27 and the piston rod 34.

With reference back to Figure 6, a rack 53 is disposed to face the rack 35 connected to the piston rod 34, and is assembled to stay in mesh with the pinion 43 slidably in the frame 42, and is further integrally fixed through a connecting pin 54 movably inserted into a longitudinal elongate hole 37 through a lower portion of the rear plate 26, to the front plate 25.

The base plate 24 is thus coupled with the moving means 23 as was heretofore described. As may be understood also from Figure 8, the piston rod 34 is suspended from the cylinder 27 in the state as shown in Figures 8, 5, and 6. Accordingly, when the piston rod 34 is hydraulically retracted into the cylinder 27 upwardly, the pinion 43 staying in mesh with the rack 35 connected thereto turns as designated by the arrow adjacent thereto in Figure 6 to cause the rack 53 integral with the front plate 25 to move downwardly as indicated by the straight arrow in Figure 6. The front and rear plates 25 and 26 slide relative to one another by means of such operations of the piston rod 34 telescoping in relation to the cylinder 27. Therefore, the hole 37 of the rear plate 26 for movably receiving the pin 54 for connecting the rack 53 to the front plate 25 must have sufficient length for the pin 54 not to be obstructed by the relative elevational movements of the front and rear plates 25 and 26.

In another manner of relative elevational movement between the front and rear plates 25 and 26, since the cylinder 27 is fixedly secured to an overhead moving mechanism 60 as will be hereinafter described in more detail, the rear plate 26 moves upwardly with respect to the cylinder 27 and the front plate 25 upon retraction of the piston rod 34 into the cylinder 27. In other words, the front plate 25 and the cylinder 27 themselves do not move at all.

As a result of the movements of the front and rear plates 25 and 26 of the base plate 24, a gate 20 of a piece 18 can be inserted into the gap between the lower end surface of the hole 28 of the front plate 25 and the bottom surface of the gate holding piece 32*b* of the holder 32 while the gap is sufficiently opened. (That is, while the piston rod 34 is upwardly retracted into the cylinder 27.) The piston rod 34 is then extended downwardly from the cylinder 27, the rear plate 26 is moved relatively downwardly with respect to the front plate 25 thereby to cause the gate 20 of the piece 18 to be held between the lower end surface of the hole 28 of the front plate 25 and the bottom surface of the gate holding piece 32*b* of the holder 32.

The base plate 24 thus constructed and operated as heretofore described sufficiently performs its function mounted to the moving mechanism 60 as briefly shown in Figures 3 and 4.

The rail 22 is installed over the injection moulding machine 10 to transfer the opened moulds in a preferable position to the next step, i.e., to a gate separator 70. The rail 22 is assembled with the moving means 23 being movable along the rail 22 by means of a motor 55 mounted on the moving means 23. A longitudinal cylinder 63 is mounted horizontally and perpendicularly on the moving means 23 with respect to the rail 22. An elevational cylinder 64 is additionally attached vertically to the front end of the piston rod 56 telescoped with the cylinder 63. The cylinder 27 is connected at the upper end thereof to the lower end of the piston rod 57 telescoped with the cylinder 64, as shown in Figure 3.

Therefore, the base plate 24 can move laterally along the rail 22 *via* the moving means 23, longitudinally *via* the longitudinal cylinder 63, and elevationally *via* the elevational cylinder 64 shown in Figure 3.

In operation of the device with the piece removing unit thus constructed, the base plate 24 is, for example, moved upwardly by the telescopic operation of the cylinder 64, is brought up to the moving means 23 by the operation of the cylinder 63, and is then disposed over the moulds of the injection moulding machine 10 by the moving means 23.

In the meantime, the pieces 18 formed immediately after the moulding are attached to the corresponding cores 52 projecting from the male mould 51 opened in the injection moulding machine 10. The cylinders 63 and 64 are telescoped to face the front plate 25 at a predetermined position with the surface of the mould 51. The cylinder 63 is further operated to approach the base plate 24 to the mould 51 in order that the gates 20 of the respective pieces 18 may enter corresponding holes 28 of the front plate 25 as was previously described.

Then, the gates 20 of the respective pieces 18 are held respectively between the holders 32 and the front plate 25 by the telescopic operation of the cylinder 27. Then, the cylinder 63 is telescoped to horizontally draw the pieces 18 from the respective cores 52 of the mould 51. However, as a matter of course, since the pieces 18 are tightly attached to the respective cores 52 of the mould 51, it is appreciated that, if they are held between the holders 32 and the front plate 25 by elevationally moving the front plate 25, they may be deformed. Accordingly, only the rear plate 26 is constructed to elevationally move relative to the front plate 25 so that the holes 28 of the front plate 25 disposed accurately in relation to the respective pieces 18 as coupled with the respective cores 52 of the mould 51 may not be

displaced.

After the pieces 18 are thus drawn from the base plate 24, the latter is raised by the cylinder 64, and is moved over the gate separator 70 to be faced, for example, with piece holders 71 of the piece separator 70 by the telescopic operations of the cylinders 63 and 64. Then, the gates 20 of the respective pieces 18 will be placed on the respective piece holders 71 and be cut as will be hereinafter described in more detail.

Since the piece removing unit is thus constructed and operated, it can remove a number of the pieces 18, which are to be moulded to become bottle-shaped containers of polyethylene terephthalate resin, immediately after the moulding and convey them to the next process step without changing the array at the moulding. Since the piece removing unit further draws the pieces from the respective cores of the mould while holding the gates of the respective pieces and conveying them as they are, it will not scratch any of the pieces 18 which could otherwise easily be subjected to scratches as formed immediately after the moulding.

Gate Cutting Unit

The gate cutting unit 12 constructed is designed to receive the pieces 18 integral with the respective gates 20 from the injection moulding machine 10 horizontally in the same array as they use in at the time of the injection moulding, intermittently convey a number of the pieces to the next process step until the next pieces 18 are injection-moulded from the injection moulding machine 10, and cut the gates 20 of the respective pieces 20 during the stoppage of the intermittent conveyance of the pieces 20.

The gate cutting unit 12 has a piece conveyor 72 for intermittently moving the respective piece holders 71 for horizontally receiving a number of the pieces 18 in the same array as they were at the time of injection moulding, at predetermined distance and speed, and a gate cutter 74 for cutting the gates 20 of the respective pieces 18 conveyed to the cutting position by the piece conveyor 72 during the stopping period of the piece holders 71.

The various components of the piece cutting unit 12 will now be described further in detail.

Piece Conveyor 72

Figures 9, 10, 11 and 13 show a preferred construction of the piece conveyor 72 of the piece cutting unit 12. The piece conveyor 72 is operated to draw a number of the pieces from the injection moulding machine, and, more particularly, to draw the pieces 18 horizontally (16 pieces as shown by way of example in the Figures) in the same array as they were at the time of injection moulding and sequentially convey the pieces 18 (4 pieces at a time in the illustrated example) to the cutting position intermittently until the next pieces are completely moulded in the injection moulding machine.

The piece conveyor 72 positions the piece holders 71 for horizontally holding the pieces 18 at predetermined intervals. A number of chains 91 are installed vertically respectively between drive sprockets 88 and guide sprockets 90 mounted on a base 73 *via* supports 87 and a mounting frame 89. The conveyor 72 provides the required number of sets each comprising a drive and a guide sprocket 88 and 90, a chain 91 and piece holders 71, in parallel.

The piece holders 71 are arranged in the same array as the cores 52 of the mould 51 in the injection moulding machine 10 in order to receive the injection moulded pieces 18 and to convey them in the same array as they were in at the time of injection moulding.

Each of the chains 91 (4 chains in the illustrated conveyor 72, but there may be fewer or more chains) for positioning the piece holders 71 at predetermined intervals is vertically engaged between the drive sprocket 88 installed on the base 73 via a support 87 and the guide sprocket 90 installed on a mounting frame 89 supported on the base 73 so that the guide sprockets 90 are directly above the sprockets 88.

Each of the drive sprockets 88 is fixedly secured to a drive shaft 86 rotatably secured in bearings in the supports 87 which are mounted on the base 73. Figure 9 shows that the drive shaft 86 is driven through a reduction gear 80, a torque limiter 81, an index unit 82, an output gear 83, and a transmission gear 84 *via* a drive gear 85 secured to one end of the drive shaft 86, by means of a prime mover (not shown).

Although the rotating force of the prime mover is intended to be continuous, to rotate the input coupling to the reduction gear 80 at constant speed, it is converted to an intermittent rotation of predetermined duration through the index unit 82. This intermittent rotation is transmitted to the drive shaft 86. Each intermittent rotation of the drive shaft 86 is such that each chain 91 is moved, through a distance equal to that between successive piece holders 71 mounted on the chain 91. Accordingly, each piece holder 71 will stop at a predetermined stopping position in turn. In other words, the piece holders 71 may always stop at intervals corresponding to the array of the pieces 18 as drawn from the mould 51 in the injection moulding machine 10.

A stopper plate 93 is fixedly disposed for setting the backward moving limit of the held pieces, at the rear of the piece holders 71 for the time being positioned on the side of each chain 91 for receiving the pieces 18, at the front side of the piece holders 71 mounted on the other side of the each chain, and particularly at the back of the piece holders 71 disposed at the cutting position. The stopper plated 93 is constructed and installed to prevent the pieces 18 supplied onto the piece holders 71 from being moved in a rearward direction, and possibly dropping from the piece holders 71, by the vibration caused by the intermittent movements of the piece holders 71 and to restrict movement of pieces 18 which are at the cutting position. More particularly, when the

pieces 18 are inserted into piece end receiving recesses 113 of the gate cutting unit 12 at the cutting position as will be hereinafter described in more detail, they are not free to move backwardly on the piece holders 71 by the inserting force.

Gate Cutter 74

Figures 9 to 15 show that when the lowermost piece holder 71 of the holders 71, which receive a set of pieces 18 arranged in the same attitude and array as they were in at the time of injection moulding in the moulding machine 10 *via* the piece removing unit 11, reaches a cutting position, following one downward movement after the pieces 18 have been so received, the gate cutter 74 is operated to cut the gates 20 from the pieces 18 which are at the cutting position.

A slide base 102 is slidably supported on a guide rail 103 which is secured, *via* a bracket 104, to the base 73. The rail 103 extends horizontally in line with the axes of the pieces 18 for the time being held by the piece holders 71 which are at the front of the conveyor 72, to the right thereof in Figure 9, just over the base 73. Thus the slide base 102 can be moved on the guide rail 103 longitudinally back and forth towards and away from the pieces 18 held by the piece holders 71.

A piston rod of the gate cutter assembly can be telescoped into a cylinder 100 which is fixedly secured to a bracket 101 fixed onto the upper front end (shown on the extreme right in Figure 9) of the base 73. This rod is connected to the slide base 102 to effect backward and forward movement thereof along the guide rail 103.

A piece end holder 111 is secured, *via* mounting plates 114 and 115, onto the upper surface of the slide base 102 to face the piece 18 for the time being at the cutting position. As particularly shown in Figures 12 and 15, the piece end holder 111 has a recess 113 which is of a short cylindrical shape to make tight contact with the bottom of the piece 18, there being a central hole through the base of the recess to allow the gate 20 to protrude out of the piece end holder 111.

A cushion member 112 is fixed into the piece end holder 111 to hold the piece 18 without any scratch or sudden movement of the piece during insertion. Thus, the recess 113 is formed by the cushion member 112 and piece holder fixture within the piece end holder 111.

As shown particularly in Figure 10, a cutter cylinder 105 is fixed to one end of the upper surface of the slide base 102 (shown at the extreme left in Figure 10) by means of a mounting fixture 106 which is separate from the piece end holder 111. A rectilinear slide bar 108 of square cross-section is connected at an end thereof to an end of a piston rod which telescopes into the cylinder 105. This slide bar 108 is supported by a guide bracket 107 fixed onto the upper surface of the slide base 102 so as to be movable in a horizontal direction perpendicular to the axes of the pieces 18 held by the piece holders 71, and along the axis of the slide bar 108.

Cutters 110 are secured *via* mounting fixtures 109 to the slide bar 108 at positions facing the piece end holders 111 which are at the cutting position in a manner such that the cutting edges of the cutters 110 make close contact with the outside surfaces of the piece end holders 111 from which the gates 20 project. Each cutter 110 can be moved slidably across the outside surface of the piece end holder 111 by movement of the slide bar 108 upon operation of the cutter cylinder 105.

During operation of the process line, the pieces 18 are drawn from the injection moulding machine 10 and are conveyed to the piece holder 71 in such an attitude that the gates 20 are directed forwardly by the piece removing unit 11. The piece removing unit 11 is then retracted from the pieces 18, and the respective piece holders 71 are moved to cause the lowermost holders 71 which now hold pieces 18 to be stopped at the cutting position. When piece holders 71 are thus stopped at the cutting position, the cylinder 100 is operated to move the slide base 102 forwards along the guide rail 103, to urge the inside surfaces of the recesses 113 tightly against the bottom ends of the pieces 18 disposed at the cutting position. Since each piece 18 thus held on a piece holder 71 makes contact at its upper end with a stopper plate 93 as was previously described, it is held tightly, at its bottom end, against the inside surfaces of the recess 113 by the forward movement of the slide base 102.

With the slide base 102 moved forwardly in this way, the cutter cylinder 105 is operated to move the slide bar 108 forwards (to the right in Figures 12 and 13), to thus cause the cutters 110 moving integrally with the slide bar 108 to separate the gates 20 projecting from the outside surfaces of the piece end holders 111 from the pieces 18.

When the cutters 110 have completely severed the gates 20 from the pieces 18, the slide bar 106 is returned, taking the cutters 110 with it, by a manner of operation of the cutter cylinder105 which is the reverse of that described above. Then the cylinder 100 is operated in the reverse manner to that described above to move the slide base 102 back to its original position.

It is to be understood that these movements of the slide base 102 forwards and backwards are executed during a period between successive intermittent movements of the piece holders 71.

The pieces 18 supplied by one operation of the piece removing unit 11 have their gates 20 severed sequentially in the manner described above. It is also to be understood that all such pieces 18 are completely separated from their gates 20 before the pieces 18 formed in the next injection moulding process are brought to the gate cutter 74.

The piece holders 71 are stationary at the time they receive the pieces 18 from the piece removing unit 11. Since, from the time when the pieces 18 are inserted into the respective piece holders 71 by the piece removing unit 11 to the

time when the piece removing unit 11 is retracted is longer than the period between two successive movements of the holders 71 required to sequentially cut the gates 20 from all the pieces 18 of predetermined number as supplied from one moulding process, the intermittent movement of the piece holders 71 must be stopped for a predetermined time when the pieces 18 are placed onto the piece holders 71 by the piece removing unit 11.

Various means may be considered for stopping the intermittent movement of the piece holders 71 for this predetermined time. One simple means, for example, comprises an electromagnetic clutch installed at the torque limiter 81 in the piece conveyor 72, and a limit switch for controlling the clutch when operation of the piece removing unit 11 is detected.

The pieces 18 with their gates thus removed are lowered while being held by the piece holders 71 by the intermittent movement of the piece holders 71, and are then dropped onto the belt conveyor 13 from the piece holders 71 when the piece holders 71 are tilted and reversely turned at the drive sprockets 88. The pieces are then conveyed to the next cooler *via* the conveyor 13.

Cooler

Figures 16 and 17 show a preferred construction of the cooler 14. The pieces 18 which have had their gates 20 cut off by the gate cutting unit 12 are conveyed to the cooler 14 *via* the belt conveyor 13 as described above.

A conveyor 120 extends obliquely with its lower end adjacent to a flat plate 142 at the end of the conveyor 13 which projects from the base 73. This conveyor 120 is constructed with an endless belt 122 engaged between two pulleys 121 and 121 provided at the two ends of the conveyor. The belt 122, as shown in Figures 16 and 17, has lateral projection straps 123 formed at equal intervals on the outer surface of the belt to convey the pieces 18 from the lower end of the conveyor to higher end as the pieces 18 engage the straps 123 by the movement of the belt 122.

A supporting plate 12 is provided to prevent the belt 122 from sagging.

A cover 130 encloses the belt conveyor 120 and has a cooling air inlet 132 at the centre of an upper or top plate 131 of the cover. Cooling air is fed into the cover 130 through this inlet 132 to lower the temperature of the hot pieces 18 formed after the injection moulding process to a predetermined low temperature thereby to bring the pieces 18 to an optimum temperature for the biaxially orientation blow moulding of next step during a time of uniform heating. Since the pieces 18 cannot be abruptly cooled when they are cooled to room temperature or lower predetermined temperature in the step of conveying the pieces 18 *via* the conveyor 120, the cooling air is spread within the cover 130 to gradually cool the conveying pieces 18. This is achieved by a number of vent holes 133 in a scattering plate 134, which is attached to the underside of the top plate 131 of the cover 130 within the cover 130 to widely distribute the cooling air from the inlet 132 *via* the vent holes 133 into the centre of the interior of the cover 130.

To obtain a sufficient spread of cooling air into the interior of the cover 130, there are no holes directly underneath the inlet 132.

A conveyor 143 is provided for feeding the pieces 18 conveyed to the upper end of the conveyor 120 to the next step.

Since, in the process line illustrated and described herein, the device for removing and conveying the pieces can remove the pieces injection-moulded in the injection moulding machine and convey them to the gate cutting unit without scratch where the gates are automatically cut from the pieces, it can shorten the time required to cut the gates from the pieces, eliminate manpower entirely, largely reduce the moulding time to complete bottle-shaped containers of biaxially orientation blow-moulded polyethylene terephthalate resin, enable automation of the respective moulding works to complete the bottle-shaped containers, and operate substantially trouble free in a relatively simple manner with relatively simple construction. Furthermore, since the process line can convey the pieces formed immediately after the injection moulding process with precision and without any scratch, and can cool the pieces thus conveyed to an optimum predetermined temperature for the heating step immediately before the biaxially orientation blow moulding process, it can prepare the pieces to obtain optimum conditions for the next moulding process step.

Although a preferred embodiment of the present invention has been described with reference to the accompanying drawings, it should be understood that numerous variations thereof may be employed without departing from the invention, and it is reiterated that the illustrated examples given herein are simply illustrative of a process line in which pieces are removed and conveyed.

Apparatus described in this Specification is also described and claimed in our co-pending Patent Application No. 79.14131 (Serial No. 2020600).

CLAIMS

1. Gate cutting apparatus for receiving pieces from an injection moulding machine horizontally in the same array as they were in at the time of the injection moulding, intermittently conveying the pieces, and sequentially cutting the gates from the pieces, comprising:

(a) piece conveying means including a number of piece holders supported on vertical chains to be intermittently moved at predetermined moving intervals for horizontally holding the pieces at positions which are spaced apart by a distance equal to that by which the piece conveying means move the pieces at each intermittent movement, and a stopper plate or plates disposed at the back of the piece holders for restricting backward

movement of each piece held by a piece holder at least when disposed at a cutting position for cutting the gate from the piece; and

(b) gate cutting means including piece end holders each of which has a piece end receiving recess for receiving an end of a piece disposed at the cutting position and which is mounted for movement forwards and backwards towards and away from the pieces held by the piece holders at the cutting position, and a cutter for cutting the gate which projects from the piece end holder, the cutter being mounted so that it is movable in a direction perpendicular to the axes of the pieces held by the piece holders so that it can perform this cutting operation.

2. Apparatus according to claim 1, further comprising piece removing means supported movably along a rail installed over the injection moulding machine and movable elevationally for removing the piece of cylindrical shape from the injection-moulding machine.

3. Apparatus according to claim 1, further comprising piece cooling means enclosed by a cover plate for cooling the piece from which the gate has been cut by said gate cutting means, with cooling air fed from a cooling air inlet.

4. Apparatus according to claim 3, in which the piece cooling means comprise:

(a) a cover which encloses an endless belt conveyor for conveying the pieces;

(b) a cooling air inlet provided at the centre of a top plate of the cover for introducing cooling air to lower the temperature of the hot pieces to a predetermined temperature appropriate for a biaxially orientation blow moulding process; and

(c) a spreader plate perforated with a number of vent holes at portions other than that directly under the inlet thereof for distributing the cooling air to the interior of the cover from the inside surface of the top plate of the cover.

5. Gate cutting apparatus substantially as described herein with reference to Figures 9 to 15 of the accompanying drawings.

New claims or amendments to claims filed on 18 May 82 and 6 Aug 82

Superseded claims 1—5

New or amended claims:—

1. Apparatus for injection moulding parisons, receiving the parisons from the injection moulding machine in the same array as they were in at the time of the injection moulding, intermittently conveying the parisons, and sequentially cutting the gates from the parisons, comprising:

(a) an injection moulding machine having a plurality of cores;

(b) conveying means including a plurality of parison holders, attached to substantially vertically-extending chains to be intermittently moved, for holding the parisons at positions which are spaced apart by a distance equal to that by which the said parison conveying means move the parisons at each intermittent movement, and a stopper plate or plates disposed at a rear side of parison holders for restricting rearward movement of the parisons held by the parison holders at least when disposed at a cutting position for cutting the gates from the parisons; and

(c) gate cutting means including a parison end holder which has a parison end receiving recess for receiving an end of a parison disposed at the cutting position and which is mounted for movement forwards and backwards towards and away from the parison or parisons held at the cutting position, and a cutter for cutting the gate which projects from the parison end holder, the cutter being mounted so that it is movable in a direction perpendicular to the axes of the parisons held by the parison holders so that it can perform this cutting operation.

2. Apparatus according to claim 1, further comprising parison removing means supported movably along a rail which is installed over the injection moulding machine, the parison removing means also being movable elevationally for removing parisons of cylindrical shape from the injection moulding machine.

3. Apparatus according to claim 1, further comprising parison cooling means having a cover plate which encloses a cooling space for cooling the parisons from which the gate has been cut by the gate cutting means, with cooling air fed from a cooling air inlet of the parison cooling means.

4. Apparatus according to claim 3, in which the parison cooling means comprise:

(a) a cover which encloses an endless belt conveyor for conveying the parisons;

(b) a cooling air inlet provided at the centre of a top plate of the cover for introducing cooling air to lower the temperature of the hot parisons to a predetermined temperature prior to a biaxially orientation blow moulding process; and

(c) a spreader plate perforated with a plurality of vent holes at portions other than that directly under the inlet thereof for distributing the cooling air to the interior of the cover from the inside surface of the top plate of the cover.

5. Gate cutting apparatus substantially as described herein with reference to Figures 9 to 15 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1982. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained