Abstract: A blow moulding machine is disclosed including at least one extrusion head for forming parisons; a mould for forming articles from the parisons, the mould including at least one mould cavity, an arrangement of blow pins for blowing the parisons in the mould to form articles; and wherein the mould is moveable with respect to the arrangement of blow pins and wherein two blow pins are provided for each mould cavity.
A BLOW MOULDING MACHINE AND METHOD OF BLOW MOULDING

Technical Field
The present invention relates to a blow moulding machine and method of blow moulding. The invention particularly relates to blow moulding of plastic bottles.

Background to the Invention
It is known to form plastic containers by blow moulding. Typically, tubular parisons are formed by an extruder head, these parisons are then blown in a mould to form containers. The containers can be used to hold a wide variety of products including cosmetics, cleaning products, chemicals, foods and drinks.

Industrial blow moulding machines can usually be configured to allow production of a wide range of articles. This is achieved by changing the mould used in the machine, and also by changing the type of plastic being used in the machine. A mould may include one or more cavities that define the outer dimensions of an article being blown in the mould. For moulds with a number of cavities, the cavities are usually identical. Multiple cavities are employed to increase the rate of production of articles by a particular machine.

The costs involved in operating a blow moulding machine include the cost of the machine, the cost of moulds, along with costs for raw materials, energy, premises and labour.

There is a continued need to improve the efficiency of blow moulding operations.

Summary of the Invention
In a first aspect the present invention provides a blow moulding machine including at least one extrusion head for forming parisons; a mould for forming articles from the parisons, the mould including at least one mould cavity, an arrangement of blow pins for blowing the parisons in the mould to form articles; and wherein the mould is moveable with respect to the arrangement of blow pins and wherein two blow pins are provided for each mould cavity.

The blow pins may be provided on a shuttle which reciprocates with respect to the at least one extrusion head.

A first actuator may effect movement between a fixed part of the machine and the shuttle, and a second actuator may effect movement between the shuttle and the mould.
The extrusion heads may be disposed above the mould and the blow pins may be disposed beneath the mould.

The blow pins may be mounted on a removable manifold.

In a second aspect the present invention provides a method of forming articles by blow moulding including the steps of: a) forming a first parison with an extrusion head; b) blowing the first parison with a first blow pin to form a first article in a mould cavity; c) at least partially forming a second parison by way of the extrusion head; d) separating the mould cavity from the first article; e) surrounding the second parison with the mould cavity; and f) blowing the second parison with a second blowpin to form a second article in the mould cavity.

In a third aspect the present invention provides a sub-assembly for use in association with a blow moulding machine including: a body which is arranged to be mounted to a blow moulding machine; a shuttle which is provided with at least two blowpins; the shuttle is moveably mounted to the body to allow the shuttle to reciprocate between first and second positions with respect to the body.

**Brief Description of the Drawings**

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figures 1 to 4 are schematic illustrations showing a blow moulding apparatus and the sequence of operations to produce an article by blow moulding according to an embodiment of the invention;

Figure 5 is an end view of a blow moulding machine according to an embodiment of the invention;

Figures 6 to 9 illustrate the sequence of figures 1 to 4 using the blow moulding apparatus of figure 5 with a four cavity mould; and

Figure 10 is a side view of a further alternative embodiment of the invention.

**Detailed Description of the Preferred Embodiment**

Referring to figure 1, a blow moulding machine 10 is shown including a nodding extrusion head 12 for forming tubular parisons 14, and two blow pins 18, 19. The blow pins are mounted on a shuttle 20 which can move between two positions as will be described. A mould 16 having a single mould cavity is shown which is able to move in relation to shuttle 20 between two positions aligned with either of blow pins 18, 19. The frame of the machine is indicated by rails 11. It is to be noted that there are twice as many blow pins as there are mould cavities.

The sequence of operations for forming an article by way of machine 10 will
now be described with reference to figures 1 to 4. The guide rails 11 remain stationary throughout the sequence. The extrusion head carries out a nodding movement up and down during the sequence, but does not move from side to side.

In figure 1, the mould 16 is aligned with blowpin 18 and contains a parison (not visible) which is being blown to form an article. Simultaneously to blowing the parison in the mould 16, another parison 14 is being formed by way of extrusion head 12. The shuttle is in its first position, to the left side of machine 10.

In figure 2, mould 16 has opened to reveal a finished article being bottle 22. Mould 16 moves with respect to shuttle 20 to align with blow pin 19. Bottle 22 is ejected from blow pin 18. The mould cavity has surrounded the parison 14 that was visible in figure 1. The parison in mould 16 begins to be blown. The parison 14 is cut from head 12 which nods upwards.

Referring to figure 3, shuttle 20 has moved to its second position along with mould 16, to the right hand side of machine 10. The parison continues to be blown in mould 16. Simultaneously to this, a second parison 14 is being formed from the extrusion head 12.

Referring to figure 4, mould 16 has opened to reveal a second bottle 22. Mould 16 moves in relation to the shuttle to align with blowpin 18 and has surrounded the parison that was shown forming in figure 3. Blowing of parison in mould 20 commences. The second bottle 22 is ejected from blowpin 17. Shuttle next moves back to its first position, which is as seen in figure 1 and the sequence repeats indefinitely producing two bottles during each sequence.

The arrangement can be scaled up by multiplying the number of extrusion heads, mould cavities and blow pins. Referring to figures 5 to 8, the sequence of figures 1 to 4 is illustrated in relation to a machine configured with a four cavity mould. Like reference numerals have been used to indicate components corresponding to the schematic illustrations of figures 1 to 4.

Referring to figures 5 and 6, a blow moulding machine 100 is shown. This machine is based on a 780D model of blow moulding machine produced by Sabman, Thailand. The machine includes a body in the form of carriage 30 which carries the components for opening and closing the mould 16 in the form of pivot arms 42 which are operated by hydraulic ram 40. Arms 42 are shown in the mould open position, the same arms 42’ are shown in ghost outline in the mould closed position. Carriage slides along guide rails 32 and is movable between positions A, B and C.

In order to implement the present invention, the carriage 30 has been modified to include a shuttle 20, which includes a bearing rail 26 that is a smooth sliding fit with bearing block 28. A first hydraulic ram is mounted between the shuttle 20 and the fixed
frame of the machine and effects reciprocal movement of the shuttle with respect to the
machine frame. A second hydraulic ram is mounted between the shuttle and carriage 30
effects movement of the carriage 30 with respect to shuttle 20. The positions of shuttle
20 and carriage 30 are controlled by operation of these two rams.

Machine 100 has been configured to include an arrangement of four nodding
extrusion heads 12, which in use continually extrude four parisons 14. A four-cavity
mould 16 has been mounted upon carriage 30. A set of four blow pins 19 are shown,
another set of four blow pins 18 is obscured by the mould 16 in figure 6.

The sequence of operations carried out by the machine will now be described
with reference to figures 6 to 9.

In figure 6 the positions of components of the machine 100 correspond to the
positions shown in figure 1. The mould 16 is aligned with blowpins 18 and contains
four parisons (not visible) which are being blown to form articles. Simultaneously to
blowing the parisons in the mould 16, another set of four parisons 14 is being formed by
way of extrusion head 12. The shuttle 20 is in its first position, to the left side of
machine 100.

Referring to figure 7, the positions of components of the machine 100
correspond to the positions shown in figure 2. Mould 16 has opened to reveal a finished
set of four bottles 22. The second hydraulic ram has operated to move carriage with
respect to the shuttle to move carriage to position C to align with blow pins 19. Shuttle
20 has remained stationary. Bottles 22 are ejected from blow pins 18. The mould
cavities have surrounded the four parisons 14 that were visible in figure 5. The parisons
in mould 16 begin to be blown. The parisons 14 are cut from head 12 which nods
upwards.

Referring to figure 8, the positions of components of the machine 100
correspond to the positions shown in figure 3. The first hydraulic ram has operated to
move both of shuttle 20 and carriage 30 together. Carriage 30 has moved to position C,
and the shuttle 20 has moved to its second position, to the right hand side of machine
10. The parisons continue to be blown in mould 16. Simultaneously to this, a second
set of parisons 14 is being formed from the extrusion heads 12.

Referring to figure 9, the positions of components of the machine 100
correspond to the positions shown in figure 4. Mould 16 has opened to reveal a second
set of bottles 22. The first hydraulic ram has operated to move carriage 30 to position B
to align mould 16 with the extrusion heads 12. During the movement of carriage 30,
shuttle remains stationary and thus remains in its second position, to the right side of the
machine. Mould 16 has surrounded the parisons that were shown forming in figure 8.
Blowing of parisons in mould 16 commences. The second set of bottles 22 is ejected
from blowpins 19. Shuttle 20 and carriage 30 move together back to their starting positions, which are as seen in figure 6 and the sequence repeats indefinitely producing two sets of four bottles during each sequence.

Referring to figure 11, an alternative embodiment of machine is shown. This arrangement is used if the blowpins 18, 19 are required to be moving blowpins which require additional clearance. In this embodiment, a modified shuttle 50 is employed underneath which the moveable blowpins 18,19 are mounted. Opposite edges 53, 55 of the shuttle 50 slide in channels 52, 54. When ram 40 (not shown) operates to spread about pivot arms 42, the shuttle resist the pivot points of the arms from moving away from one another. The pivot arms have been removed and the mould 16 is operated directly by two hydraulic rams 60.

By way of the invention, efficiency of the machine is increased by reducing the idle time of the mould.

In the embodiment described in figures 5 to 9, sets of four blowpins were used. In other embodiments, different numbers of blowpins can be used. The sets of blowpins may be provided as a removable manifold, thus improving the ease with which the machine can be reconfigured for different production runs requiring different numbers of blowpins.

In the embodiment described above the parisons were continuously extruded from the extrusion head. In other embodiments, the extrusion can be stopped and restarted between the formation of each parison.

Any reference to prior art contained herein is not to be taken as an admission that the information is common general knowledge, unless otherwise indicated.

Finally, it is to be appreciated that various alterations or additions may be made to the parts previously described without departing from the spirit or ambit of the present invention.
CLAIMS:

1. A blow moulding machine including:
   at least one extrusion head for forming parisons;
   a mould for forming articles from the parisons, the mould including at least one mould cavity,
   an arrangement of blow pins for blowing the parisons in the mould to form articles; and
   wherein the mould is moveable with respect to the arrangement of blow pins and wherein two blow pins are provided for each mould cavity.

2. A blow moulding machine according to claim 1 wherein the blow pins are provided on a shuttle which reciprocates with respect to the at least one extrusion head.

3. A blow moulding machine according to claim 2 wherein a first actuator effects movement between a fixed part of the machine and the shuttle, and a second actuator effects movement between the shuttle and the mould.

4. A blow moulding machine according to any preceding claim wherein the extrusion heads are disposed above the mould and the blow pins are disposed beneath the mould.

5. A blow moulding machine according to any preceding claim wherein the blow pins are mounted on a removable manifold.

6. A method of forming articles by blow moulding including the steps of:
   a) forming a first parison with an extrusion head;
   b) blowing the first parison with a first blow pin to form a first article in a mould cavity;
   c) at least partially forming a second parison by way of the extrusion head;
   d) separating the mould cavity from the first article;
   e) surrounding the second parison with the mould cavity; and
   f) blowing the second parison with a second blowpin to form a second article in the mould cavity.

7. A sub-assembly for use in association with a blow moulding machine including:
   a body which is arranged to be mounted to a blow moulding machine;
   a shuttle which is provided with at least two blowpins;
   the shuttle is moveably mounted to the body to allow the shuttle to reciprocate between first and second positions with respect to the body.
A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.
B29C 49/60 (2006.01) B29C 49/04 (2006.01) B29C 49/42 (2006.01)
B29C 49/00 (2006.01) B29C 49/28 (2006.01) B29C 49/58 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI; EPODOC: B29C49/-, B29C 47/00, 47/02, 47/04, 47/06, 47/08, 47/10, 47/12, 47/14, 47/16, 47/18, 47/20, 47/22, 47/24, 47/26, 47/28, 47/30 and (parison+ or bottle+ or container+ or vessel+) and m[o,ou]ld 4d (mov+ or adjust+ or align+ or centre+ or in_line or position+) and (blow+ 4d (pin+ or needle+ or inject+ or nozzle+ or aperture+)) and (back 2d forth or to 2d from or up 2d down) and shuttle+ or (horizontal+ or lateral+ or transversal+ or sideways or side_to_side)

B29C 49/- and (extrude+ or extrude+ and (parison+ or perform+)) or (pre_form+ or pre-shap+) and cav+ and +pin+ and (mov+ or shuttle+ or reciprocat+).

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 2003/009 1683 A1 (JOHNSON) 15 May 2003 Abstract: paragraph [0005], [0016] - [0027]; figures; claims</td>
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<td>US 4375947 A (MARCUS) 8 March 1983 Abstract: column 1, line 50 - column 2, line 6; column 5, line 16 - column 6, line 44; figures</td>
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[X] Further documents are listed in the continuation of Box C
[X] See patent family annex

Date of the actual completion of the international search
01 July 2011

Date of mailing of the international search report 11 I 2011

Name and mailing address of the ISA/AU
AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pat@ipaustralia.gov.au
Facsimile No.: +61 2 6283 7999

Authorized officer
GREGORY DIVEN
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No.: +61 2 6283 2992

Form PCT/ISA/210 (second sheet) (July 2009)
INTERNATIONAL SEARCH REPORT

Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ ClaimsNos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

[See Supplemental Box]

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

□ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

□ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

□ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)
## INTERNATIONAL SEARCH REPORT

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Form PCT/ISA/2 10 (continuation of second sheet) (July 2009)
Supplemental Box

(To be used when the space in any of Boxes I to LV is not sufficient)

Continuation of Box No: .

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-5 are directed to a blow moulding machine including: at least one extrusion head for forming parisons; a mould for forming articles from the parisons, the mould including at least one mould cavity, an arrangement of blow pins for blowing the parisons in the mould to form articles; and wherein the mould is moveable with respect to the arrangement of blow pins and wherein two blow pins are provided for each mould cavity. The feature of a blow moulding machine including: at least one extrusion head for forming parisons; a mould for forming articles from the parisons, the mould including at least one mould cavity, an arrangement of blow pins for blowing the parisons in the mould to form articles; and wherein the mould is moveable with respect to the arrangement of blow pins and wherein two blow pins are provided for each mould cavity is specific to this group of claims.

- Claim 6 is directed to a method of forming articles by blow moulding including the steps of: a) forming a first parison with an extrusion head; b) blowing the first parison with a first blow pin to form a first article in a mould cavity; c) at least partially forming a second parison by way of the extrusion head; d) separating the mould cavity from the first article; e) surrounding the second parison with the mould cavity; and f) blowing the second parison with a second blowpin to form a second article in the mould cavity. The feature of a method of forming articles by blow moulding including the steps of: a) forming a first parison with an extrusion head; b) blowing the first parison with a first blow pin to form a first article in a mould cavity; c) at least partially forming a second parison by way of the extrusion head; d) separating the mould cavity from the first article; e) surrounding the second parison with the mould cavity; and f) blowing the second parison with a second blowpin to form a second article in the mould cavity is specific to this group of claims.

- Claim 7 is directed to a sub-assembly for use in association with a blow moulding machine including: a body which is arranged to be mounted to a blow moulding machine; a shuttle which is provided with at least two blowpins; the shuttle is moveably mounted to the body to allow the shuttle to reciprocate between first and second positions with respect to the body. The feature of a sub-assembly for use in association with a blow moulding machine including: a body which is arranged to be mounted to a blow moulding machine; a shuttle which is provided with at least two blowpins; the shuttle is moveably mounted to the body to allow the shuttle to reciprocate between first and second positions with respect to the body is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature there is no unity of invention.

[See Supplemental Box B]

Form PCT/ISA/210 (extra sheet) (July 2009)
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In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claims and therefore cannot provide the required technical relationship. The only feature common to all of the claims and which provides a technical relationship among them is blow moulding using at least two blow pins. However this feature does not make a contribution over the prior art because it is disclosed in:

US 2002/018284 A1 (SINGLETON) 5 December 2002

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature present in the claims and the requirements for unity of invention are consequently not satisfied _a posteriori._
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.