We, O.N.V. SpA
67, Via Lungadige Attiraglio, 1 - 37025 Parona, Italy
hereby apply for the grant of a standard patent for an invention entitled Process and apparatus for moulding the edge of containers of synthetic thermoplastic material, which is described in the accompanying specification.

(*To be included in the case of a Convention application)*

Details of basic application(s)

Number of basic application: 85008-A/89
Name of Convention country in which basic application was filed: Italy
Date of basic application: 18th December, 1989

*(To be included in the case of an application made by virtue of section 51)*

Number of original application:

Person by whom made:

*(To be included in the case of an application for a patent of addition)*

I request that the patent may be granted as a patent of addition to the patent applied for or: Application No.: Patent No.: In the name of:

I request that the term of the patent of addition be the same as that for the main invention or so much of the patent for the main invention as is unexpired.

HALLIDAYS
My address for service is: 44, Ashley Street, Hornsby, N.S.W. 2077, Australia

14th December 1990

O.N.V. SpA
By its Patent Attorneys, HALLIDAYS.

R.G. Halliday

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952
COMMONWEALTH OF AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION UNDER
PART XVI FOR A PATENT OR PATENT OF ADDITION

In support of the Convention application made for a patent for an invention entitled
PROCESS AND APPARATUS FOR
MOULDING THE EDGE OF CONTAINERS OF SYNTHETIC THERMOPLASTIC MATERIAL

I/we

Robert G. Halliday, Patent Attorney

of 44 Ashley Street, Hornsby, N.S.W. 2077

I do solemnly and sincerely declare as follows:

1. I am/we are the applicant(s) for the patent of addition.

2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following date(s) namely:

   in Italy on 18.12.89 No. 85008-A/89
   by O.M.V. SpA
   in No. 
   by 
   in No. 
   by 

3. I am/we are the actual inventor(s) of the invention referred to in the basic application

   Pietro PADOVANI

of Via Carlo Ederle 45, 37126 Verona, Italy

I am/we are the actual inventor(s) of the invention and the facts upon which I/we am/are entitled to make the application are as follows:

(k) the inventor is the managing director of the applicant company and under contract of service the applicant company is the owner of the invention

4. The basic application(s) referred to in paragraph 2 of this Declaration was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at Sydney this 14th day of December 1990

(Signature of Declarant)
1. A process for forming the edge of containers of synthetic thermoplastic material which are open at the top and terminate in an outer flange which is arched upwards and extends downwards, in which the process includes the following stages, which can be repeated cyclicly:

- feeding from one or more stacks of containers,
- heating of the flange so as to enable the edge to be formed,
- displacing at least the top container from each stack of remaining containers,
- removing the top container from the remaining containers in a stack,
- positioning the latter in a female mould which holds the said container coaxially with respect to its longitudinal axis,
- forming and final stabilisation of the edge by compression over the full extent of the heated flange by closure of the male and female moulds,
- expulsion of edged containers from the female moulds into at least one stacking channel,
natural or forced cooling of the female mould before another container is placed within it for subsequent edging, and also in which the first four stages can be separated from the others and also function when the others are stopped, thus offering a choice between continuing to produce heated flanges while awaiting reactivation of the other stages or completely emptying the container heating zone, with the recovery of unedged containers with heated flanges in both cases.

3. An apparatus for carrying out the process as claimed in claim 1 or 2 comprising a feed device from stacks of containers having flanges, means for heating the flanges, means for removing the top containers from each stack, means for positioning the said containers in female moulds, means for final forming and stabilisation of the edges and means for expulsion and stacking in order to remove edged containers from the moulds and discharge them towards a stacking channel.
TO BE COMPLETED BY APPLICANT

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Complete Specification for the invention entitled: PROCESS AND APPARATUS FOR FORMING THE EDGE OF CONTAINERS OF SYNTHETIC THERMOPLASTIC MATERIAL

The following statement is a full description of this invention, including the best method of performing it known to me:
PROCESS AND APPARATUS FOR FORMING THE EDGE OF CONTAINERS OF SYNTHETIC THERMOPLASTIC MATERIAL

The invention relates to a process for forming the edge of a container of synthetic thermoplastic material which is open at the top and ends in an outer upwardly arched and downwardly extending flange, and an apparatus for carrying out this process.

Processes for edging containers of synthetic thermoplastic material which are open at the top and terminate in an outer flange based on the deformation of the said flange which is heated to a temperature such as to render the material plastic by means of several endless screws with threads of variable cross-section are known from British Patent Nos. 951,242 and 1,101,031. By these means, the flange is deformed and rounded into the desired shape by a plurality of edging members which rotate relative to the container which is to be edged.

In these processes heating of the flange is an integral part of the edging cycle, and in the event of the edging members being stopped a plurality of containers remain held between the channels formed by the heating rollers, which because of their high temperature rapidly cause melting of the flanges of the trapped containers, with disadvantages due to the presence of molten material between the threads of the said rollers.

In this situation it is necessary to stop the machine for a long period so that the trapped containers can be removed and the threaded rollers can be cleaned.
A further loss of time is involved in returning the threaded rollers to their proper temperature before edging is resumed.

In the edging processes mentioned above, the band which bends and rounds the flange cannot perform its proper function when the thickness of the flange exceeds specific values.

In band edgers each edging member compresses the flange radially at the points of contact between the flange and the edging rollers, making it difficult to maintain the diameter of the container mouth perfectly circular and the thickness of the edge obtained constant.

With the edging processes mentioned, containers, for example of crystalline polystyrene, do not withstand the torsion due to rotation of the container with respect to the band. This torsion sets up tensions which result in collapse of the material in question. With containers of polypropylene for example, the edging permits easy unrolling of the edge because the latter is not sufficiently stabilised on leaving the machine.

The primary object of the invention is to make it possible to edge containers of crystalline polystyrene, polypropylene and the like while eliminating the deficiencies of known edging processes.

According to the present invention there is provided a process for forming the edge of containers of synthetic thermoplastic material which are open at the top and terminate in an outer flange which is arched upwards and extends downwards, in which the
process includes the following stages, which can be repeated cyclicly:

- feeding from one or more stacks of containers,
- heating of the flange so as to enable the edge to be formed,
- lifting of at least the top container from each stack of the remaining containers,
- removal of the top container from the remaining containers in the stack,
- positioning the top containers in female moulds which hold the said containers coaxially with respect to their longitudinal axes,
- forming and final stabilisation of the edge by compression applied to the entire extent of the heated flange by closing the male and female moulds,
- expulsion of the edged containers from the female moulds into at least one stacking channel,
- natural or forced cooling of the female mould before another container is placed within it, and
- in which the first four stages can be separated from the others and also operate when the others are interrupted, so that a choice may be made between continuing to produce heated flanges while reactivation of the other stages is awaited and complete emptying of the container heating zone, in both cases with the recovery of containers with heated flanges not subjected to edging.

The apparatus of the invention comprises a device for feeding containers from stacks of flanged containers, means for heating the flanges, means for removing the top containers from each stack, means for positioning the said containers in female moulds, means for final forming and stabilisation of the edges, means for expulsion and stacking, means to take edged
containers from the female moulds and to discharge them into a stacking channel.

The main advantage deriving from the process according to the invention and the apparatus which implements same arises from the fact that it is also possible to edge containers of crystalline polystyrene, polypropylene and similar materials.

Another advantage is due to the fact that the said process and the said apparatus make it possible to manufacture containers with a perfectly circular mouth and with an edge of constant height and thickness.

Another advantage arises from the fact that when special plastics materials are used, such as for example normal polystyrene, the flange heating temperature can be kept below values appropriate to known processes, while in the case of high-impact polystyrene, a material commonly used for the manufacture of beakers for drinks, edging can take place without any heating of the flange, thus providing appreciable energy savings and reducing production costs.

Another advantage from the fact that the first four stages of the process can be separated from the rest, so that in the event of a fault or obstruction in the forming station, the means implementing the first four stages can be made to recover the containers, avoiding them becoming trapped and overheated, with the disadvantages deriving therefrom, without therefore interrupting the feed and the heating. Once repair work at the edge forming station has been completed, edging can be resumed immediately, the means implementing the first four
stages being returned to their normal working positions.

The present invention will be further illustrated, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a partially interrupted cross-sectional view of a machine according to the invention with a feed, heating and discharging unit incorporated in the cycle;

Fig. 2 is a partially interrupted cross-sectional view of the machine of Figure 1 with the feed, heating and discharging unit isolated from the cycle;

Fig. 3 is a partially interrupted cross-sectional view, at right angles to the direction of advance of the containers, of the heating device of the machine of Fig. 1.

Fig. 4 is a view in partial cross-section taken along the line 4-4 of Fig. 3;

Fig. 5 is a partially interrupted and magnified cross-sectional view of a detail of Fig. 4;

Fig. 6 is a frontal view of the plate supporting the female moulds in a machine according to the invention;

Fig. 7 is a partially interrupted cross-sectional view of a male mould and a female mould open with a beaker positioned for edging;
Fig. 8 is a similar view to the above, with the moulds closed and the beaker edged; and

Fig. 9 is a partially interrupted cross-sectional view of the air blowing device for positioning beakers between the female moulds.

Bearing in mind the fact that identical numerical references in the figures correspond to identical or equivalent parts, it will be seen in Fig. 1 that there is a feed device substantially consisting of a conveyor belt 30 mounted on rollers 30', 30", of which 30' is the driving roller, located at the mouth of the machine implementing the process according to the invention.

Stacks of beakers 27 are supported on this belt and are pushed therefrom between funnels 29 which convey each stack of beakers 27 to a device in which their flanges are heated.

The heating device comprises sets of rollers 22, 22', 22", rotatably supported by means of a moving frame 25, having heads 24, 24', and driven by a motor by means of a suitable means for transferring the motion, such as e.g. belts, chains or gearwheels, which are not shown in the drawing. The rollers in each set are threaded externally so as to form an endless screw, with a thread of constant pitch and cross-section, as may be seen in Figs. 4 and 5, with a flat crest 38 and a flat-bottomed root 37. The pitch of these threads is greater than the stacking pitch of beakers 27 located on belt 30.

Although not illustrated in the drawings, the pitch of these threads may be identical to that for the
stacking of beakers 27 and may increase in the final portion of the said sets of rollers so as to separate at least top container 21 from a stack of remaining containers, in order to aid removal of the top container at the end of the heating stage.

As will be seen in Fig. 5, cavity 37 of the screw has dimensions such as to contain flange 35 which is to be edged, whereby the beakers are taken up one at a time and removed from the others in the stack.

Each cylinder 22, 22', 22" is attached to a thermocouple 28 capable of heating the entire roller to its outer surface. The amount of heat supplied is sufficient also to heat the flange of beakers which may be constructed of polypropylene or other complex plastics materials which are not sufficiently deformable at moderate temperatures.

As will be seen in Fig. 3, the axes of the rollers in these sets are placed symmetrically and at a spacing which can be adjusted by means of rack regulators 32 in such a way that the three sets of beakers 21 are aligned. The rotation of heating cylinders 22, 22', 22" causes the entire beaker to rotate about its own longitudinal axis so that the point of contact between the threads of the three rollers and flange 35 of the beaker continuously changes, and thus the entire flange is heated by the time it leaves the endless screw.

As will be seen in Fig. 9, beakers 21 are removed from the outlet of the threaded roller heating device by means of a jet of compressed air from three nozzles 36 located parallel to the longitudinal axis of the beakers being edged and connected to an air
compressor which is not illustrated in the drawing. The pressure of the air in the nozzles is a minimum, given that the beakers have already been separated from the remainder still being heated. These air jets are directed radially and in the direction of advance indicated by arrow 20 in Fig. 4, in such a way as to pass into the space separating top container 21 from the others being heated, creating a greater pressure on the inside of the base of the beaker than that acting on the outside of the said base. Under the effect of this thrust beakers 21 enter female moulds 49 of the edging device, which as may be seen in Figs. 1 and 2 consists of two plates 40 and 41.

Circular plate 40 bears 12 female moulds while plate 41 bears 3 male moulds 50.

Female moulds 49 are distributed in groups of three along the sides of a square whose centre coincides with the axis of rotation of the said plate. On the top side of the square are located the three positions 42 for entry into the female moulds, on the right hand side are the three positions 43 for the forming of the edge, at the base there are the three positions 44 for removal, and on the left hand side there are finally the three positions 45 of the female moulds which remain always empty and are cooled by natural or forced loss of the heat absorbed during forming and stabilisation of the edge.

By means of a continuous succession of partial rotations of a quarter turn of plate 40 pressed onto shaft 54, connected by means of a support 53 to a reduction gear mechanism 60 driven by a motor which is not illustrated, each set of female moulds is carried cyclicly through the various positions into position 43.
for forming the edge opposite a set of male moulds 50. The said male moulds move in an alternating way along their own axial direction driven by an eccentric device 26 via a connecting rod 55 of adjustable length of which one end is attached to pin 57 and by means of supports 58 of plate 41 which bears male moulds 50. Said supports 58 slide between guides 59 integral with fixed frame 23 which also supports moving frame 24, 24', 25.

Internally, and downstream of the forming surfaces, as may be seen in Figs. 7 and 9, each female mould is provided with a sealing member 46 consisting of a ring having an elastically deformable lip 47 which projects towards the interior of the said mould. When in the resting position, the minimum circumference of this lip is slightly less than that of the corresponding portion of the glass against which the seal is made, while in the stressed condition it adopts the same dimension as the circumference of the portion of glass with which it is in contact.

Beaker 21, substantially frustoconical shape, driven by the air blasts from nozzles 36, enters the female mould and is positioned as illustrated in Fig. 7, i.e. with one end 35' of flange 35 almost in contact with profile 48 of the female mould.

Said ring 46 together with lip 47 holds the beaker in position during the stage in which plate 40 rotates, transferring the beakers from delivery position 42 to forming positions 43 and subsequently from these to expulsion positions 44.

In order to prevent the beakers from taking up undesirable positions during the positioning stage,
and obstructing the machine at the outlet from the flange heating zone, three guide rollers ensuring correct lateral movement of the beakers are provided and are integral with plate 24 of movable frame 25 which supports both the feed device and the flange heating device.

Once three beakers 21 have been positioned between the female moulds 49 which are located in position 42, plate 40 makes a first quarter turn rotation, transferring the moulds and the corresponding beakers to position 43 and moving the set of empty moulds 49 from position 45 to 42.

Closure of the male moulds 50 onto female moulds 49 takes place when the female moulds are in position 43 and brings about mechanical deformation of the flanges by compression, while a further set of top beakers 27 are positioned in moulds 49 which have reached position 42.

Male moulds 50 with their annular recesses 50', see Fig. 7 and 8, compress the arched portion towards the top of flange 35 and cause beakers 27 to advance axially between the holes in female moulds 49. As the beakers advance in the holes of the moulds lip circumference 47 increases in diameter and has a maximum diameter when the beakers cease to advance. During this entry of beakers 27 into the female moulds, flange 35, the outer edge of whose extremity 35' is in contact with profile 48 of female mould 49, is stressed by the annular taper 49' of profile 48 of the female mould and by the compression exerted by annular recesses 50' of the male mould so as to bend inwardly in order to take up the final position illustrated in
Fig. 8, where moulds 49 and 50 are shown completely closed.

From what has been said it will be clear that the combined compressive effect mainly exerted by annular recess 50' and by taper 49' acts simultaneously over the entire outer surface of flange 35. As a consequence a strong cooling effect which finally stabilised the entire edge acts over the full surface of the flange.

The mouth diameter of a container whose edge has been obtained as described above must correspond exactly to the diameter imposed by the male mould with its annular recess 50', while the height of this edge cannot be different from that imposed by the male and female moulds which close upon each other, as may be seen in Fig. 8.

These characteristics of dimensional homogeneity in containers edged and described above are particularly important when the containers, e.g. beakers, must be used in drinks distribution machines because they assist delivery of the beakers stacked within the distribution machines without any possibility of obstruction. The same applies to containers, e.g. pots, containing yogurt and the like used in automatic filling and sealing machines.

In the edging machines described in British Patent Nos. 951,242 and 1,101,031, the compression and cooling effects exerted on flanges of the containers take place only by means of rolling contact at the points of contact between the threaded rollers and the flanges, with consequently limited effects. On the other hand, according to this invention, the
compression and cooling effects exerted on the flanges of the containers take place as a result of almost static contact over the entire surface of each flange substantially corresponding to the forming surfaces of the male and female moulds, with effects which are far superior to those provided by the known art.

Practical tests have demonstrated that simultaneous compression over the entire surface of the flange makes it possible to edge flanges of appreciable thickness, even when they are made of materials which are particularly resistant to being worked, which cannot be rolled using threaded roller edging members.

When edging is complete, moulds 49 and 50 are opened so as to allow moulds 49 to be moved from positions 43 to 44 by means of a further quarter turn rotation of plate 40.

While moulds 49 remain in positions 44, an expulsion device indicated generically by 51 projects edged containers 34 from moulds 49 pushing them out of rings 46 whose lips 47 elastically return their initial shape, ready to accept new beakers for a subsequent edging cycle. Expulsion device 51 then causes edged containers 47 to enter stacking channels in order to be subsequently sent to store.

Although not illustrated in the drawing, sealing ring 46 may be replaced by a plurality of annular sectors having the same function as the entire ring, without going beyond the scope of possible embodiments of the invention.
A further 90° rotation of plate 40 brings mould 49, freed from edged containers, into positions 45. While in positions 45, although not illustrated in the drawing, moulds 49 may easily be subjected to forced cooling, for example by means of jets of cold air, where particular operating requirements necessitate it.

A further 90° rotation of plate 40 returns moulds 49 to positions 42 from which they started and while the moulds remain in these positions new containers 21 are positioned to start a new edge forming cycle.

In the machine according to the invention illustrated in Figs. 1 and 2, means effecting the first four stages of the process are supported on a movable frame 25 to the heads 24 and 24' of which heating rollers 22, 22', 22'' are secured by means of removable bolts 31, 33, while behind head 24' again of said movable frame 25 is mounted feed device 30, 30', 30''. Said frame 25 can be moved by any known means from the normal operating position illustrated in Fig. 1 about an axis 52 to adopt the position illustrated in Fig. 2.

The feed direction indicated by arrow 20 in Fig. 1 then changes to the direction indicated arrow 20' in Fig. 2, whereby beakers 21 leaving heating channels 22, 22', 22'' are pushed by the air jets from nozzles 36 onto plate 40.

As a result of the ability of the feed and heating unit to rotate about axis 52, the stages of feeding, heating and removing top containers 21 can be separated from the remaining edging stages. By this
means, if small faults occur in the edge forming device the said stages can be kept in operation while the edge forming device is stopped. In this case the objects which are to be edged, which in the meanwhile continue to flow through the heating zone, are discharged into a suitable recovery container, or enter stacking channels which are not illustrated in the drawing.

This also makes it possible to maintain the flange temperature of the glass which are to be edged within values such that the subsequent edging stage can be resumed immediately the fault has been repaired, during short stoppages.

In the event of a prolonged stoppage due for example to faults which cannot immediately be repaired the feed to the edge heating device is taken off line, while the objects located between the heating rollers continue to advance. By this means the said rollers are completely emptied, and the objects located in the heating device are recovered.

It is clear that in practical implementation of the process all structural variants of the machine must be regarded as falling within the scope of the invention, including those necessary for edging the flanges of square or rectangular mouthed containers.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A process for forming the edge of containers of synthetic thermoplastic material which are open at the top and terminate in an outer flange which is arched upwards and extends downwards, in which the process includes the following stages, which can be repeated cyclicly:

- feeding from one or more stacks of containers,
- heating of the flange so as to enable the edge to be formed,
- displacing at least the top container from each stack of remaining containers,
- removing the top container from the remaining containers in a stack,
- positioning the latter in a female mould which holds the said container coaxially with respect to its longitudinal axis,
- forming and final stabilisation of the edge by compression over the full extent of the heated flange by closure of the male and female moulds,
- expulsion of edged containers from the female moulds into at least one stacking channel,
- natural or forced cooling of the female mould before another container is placed within it for subsequent edging, and also in which the first four stages can be separated from the others and also function when the others are stopped, thus offering a choice between continuing to produce heated flanges while awaiting reactivation of the other stages or completely emptying the container heating zone, with the recovery of unedged containers with heated flanges in both cases.
2. A process for forming the edges of containers of synthetic thermoplastic material as claimed in claim 1, substantially as hereinbefore described and illustrated.

3. An apparatus for carrying out the process as claimed in claim 1 or 2 comprising a feed device from stacks of containers having flanges, means for heating the flanges, means for removing the top containers from each stack, means for positioning the said containers in female moulds, means for final forming and stabilisation of the edges and means for expulsion and stacking in order to remove edged containers from the moulds and discharge them towards a stacking channel.

4. An apparatus as claimed in claim 3, in which the feed device from stacks of containers having flanges comprises a frame supporting in a hinged manner at least three rollers which are threaded externally and form endless screws; a motor for moving the said rollers in which device for heating the flanges consist of a thermocouple system attached to the said rollers and in which the device for removal of top containers and for positioning the latter in the female moulds consists of a compressed air system connected to at least two nozzles located parallel to the longitudinal axis of the containers being heated, the air jets from which are orientated radially and in the direction of the female moulds so as to enter the space separating the top container from the other containers in a stack by establishing a pressure on the inside of the base of the container which is greater than that acting on the outside of the said base so as to push the container into the female mould.
5. An apparatus as claimed in claim 3 or 4 in which the means for forming the edges consists of an intermittently rotating plate which supports at least one female mould provided internally and downstream of the forming surfaces with a member for sealing the portion of the container body, a plate which can be displaced axially and alternately, supporting at least one male mould which closes onto a female mould whenever the plate comes to a stop, and means for moving the said plates.

6. An apparatus as claimed in claim 5, in which the sealing member comprises a ring located on the posterior portion of the female mould projecting towards the interior thereof, having an elastically deformable lip, which in the resting position has a minimum circumference slightly smaller than that of the corresponding portion of the container against which the seal is made, while in the stressed condition it adopts the circumferential dimensions of the portion of the container with which it is in contact.

7. An apparatus as claimed in claim 6, in which the sealing member consists of a plurality of annular sectors projecting towards the interior of the mould each provided with an elastically deformable lip.

8. An apparatus as claimed in any one of claims 3 to 7 in which the feed and heating means and means for removal of the top containers from the stacks can be uncoupled from the remaining devices so that the desired temperature of the heating rollers can be maintained and altered and the containers leaving the heating zone can be recovered without interrupting the feed of containers to the heating zone, or recovering only containers between the heating rollers.
interrupting the feed of containers to the said heating zone.

9. An apparatus as claimed in claim 8 in which the unit consisting of the conveyor belt and the threaded rollers can be rotated pivotally about an axis located at the distal part of the said rollers and positioned at right angles to the direction of advance of the containers which are to be edged, and in which the said unit remains active while the device for forming the edges is deactivated, and discharges the containers with heated flanges to a recovery device.

10. An apparatus for forming the edge of containers of synthetic thermoplastic material substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 14th day of December, 1990

O.M.V. SpA
By its Patent Attorneys,
HALLIDAYS.