The stacking system provides a cage having generally parallel tie bars extending longitudinally around a perimeter for the articles to be held. The tie bars are supported in at least one bracket, and have portions thereof protruding slightly inwardly from the perimeter, so as to slightly squeeze the articles placed therein and to thereby hold them.
STACKING SYSTEM FOR INJECTION MOLDED ARTICLES

REFERENCE TO RELATED APPLICATION(S)

[0001] This application is a formal application based on and claiming the benefit of provisional application No. 60/517,393, filed Nov. 6, 2003.

BACKGROUND OF THE INVENTION

[0002] This invention relates to stacking, of flexible articles, and especially to stacking of injection-molded articles as they are removed from their molds.

[0003] Injection-molded articles such as thin wall containers are used as the preferred means of packaging in an ever-growing variety of applications, mainly in food and beverage producing industries. Typical examples of these containers are conical cups for yogurt, sour cream and other dairy products and round or rectangular tubs for margarine, cottage cheese and a list of other groceries. Typical examples of “accessories” to those containers are flat lids, circular or rectangular in shape, and closures, some with asymmetric shapes. The applicability of the invention is not limited to the aforementioned specific articles. They are merely examples of the types of articles which the invention can accommodate. Similarly, the invention is not necessarily limited to injection molded articles, though that is the primary application.

[0004] The prevalent, most economical production method for these plastic commodities is injection molding. The latest technology entails single phase or stack molds with up to 24 cavities and cycle times of five seconds or less. These ever-increasing production volumes cause new challenges to the post-mold handling of these containers and their accessories, in particular with stacking and packaging, where the properties of some parts add complicating factors to the tasks at hand. For example, some parts may not stack in the first place, e.g. flat lids. Others may stack but the stacks are not sufficiently stable for further handling and transfer. Other parts have features prohibiting certain maneuvers e.g. non-circular lids cannot get re-oriented and stacked by spin bars, nor can pronounced three-dimensional parts.

SUMMARY OF THE INVENTION

[0005] In view of the above, it is an object of the invention to provide a stacking system for various injection-molded or other flexible articles capable of effectively handling volumes of such articles.

[0006] Accordingly, according to one aspect of the invention, the stacking system provides a cage having generally parallel tie bars extending longitudinally around a perimeter for the articles to be held. The tie bars are supported in at least one bracket, and have portions thereof protruding slightly inwardly from the perimeter, so as to slightly squeeze the articles placed therein and to thereby hold them.

[0007] The invention lends itself to the secure handling of thin wall containers and accessories of a wide variety of shapes and features, thus providing a reliable link between existing high-speed robotic parts removal systems, and packaging, i.e. loading boxes with stacks of containers or accessories, e.g. lids and closures. The invention accommo-

dates a wide variety of shapes, and articles with molded-on attachments, e.g. strapped lids, or in more general terms, parts with features which may render them unstackable by existing methods, e.g. freestanding vertical stacks, spin bar machines, open-trough horizontal stackers, multi-orifice belt or link conveyors, etc.

[0008] The invention creates the possibility of stacking mass-produced thin wall containers and accessories, with disparate shapes and properties, which otherwise may render them essentially unstackable. The invention may permit the use of one stacking system for quite different parts as long as their defining perimeter dimensions are identical. Of course, the invention is perfectly suitable for stackable parts as well and, in most cases, will be more cost effective than “conventional” systems.

[0009] Further details of the invention will be described or will become apparent in the course of the following detailed description and drawings of specific embodiments of the invention, as examples.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Embodiments of the invention will now be described, by way of example only, with reference to the attached drawings, in which:

[0011] FIG. 1 is a front view of a typical stacking cage according to a preferred embodiment of the invention, with four solid rods as be bars, held in a square flange;

[0012] FIG. 1A is a corresponding perspective view;

[0013] FIG. 2 is a front view of an alternative embodiment, having three hollow tubes as tie bars, held in a circular flange;

[0014] FIG. 2A is a corresponding perspective view;

[0015] FIG. 3 shows an enlarged detail of FIG. 2, showing an indentation in the rim of a cup, creating the desired “squeeze” caused by the tie bar;

[0016] FIG. 4 is a front view of a stacking cage with four tie bars arranged in an asymmetric fashion, holding in place an otherwise unstackable circular closure with a strapped-on lid;

[0017] FIG. 4A is a corresponding perspective view;

[0018] FIG. 5 shows an otherwise unstackable plastic part in the shape of a rectangular base cover with attached oval top lid;

[0019] FIG. 5A is a corresponding perspective view;

[0020] FIG. 6 is a split view showing infeed and outfeed ends of a cage; and

[0021] FIG. 7 is a perspective view of a stacking cage, having tie bars and connector flanges, showing an end effector of a robotic stack separator module (not shown), with a stack of conical cups separated from the stack continuum.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The advent of high-speed robotic parts removal systems, for example the Viper SE (trademark) robots manufactured by Ventax Robot Inc. of Ayr, Ontario, Canada, has
made maintaining the orientation of the parts throughout the transfer to the post mold stacking facility an affordable and viable option. A particularly elegant way to stack parts, presented by the end-of-arm tool of such a robotic parts removal system just outside the mold of an injection molding machine, is to hand over the parts directly into the stacking device of the invention, creating either as many stacks as there are cavities in the mold, e.g. 16, or a fraction of that number, e.g. 8 or 4, if the cycle time and other circumstances allow for multiple, sub-sequential hand-over actions. The stacks may be built up either vertically or horizontally or in any inclination, depending on favorably catering to other post-mold operations, i.e. printing, assemblies, packaging, etc.

[0023] At the core of the invention is a channel or cage built of three, four or more rods or tubes, acting as tie bars, held in place by precision-machined flanges or brackets.

FIGS. 1 and 1A thus show a typical cage 1 with four tie bars 2, in this case solid rods, held in a flange or bracket 4, in this case square, with segments 5 of the tie bars protruding slightly into the space of the perimeter of the article 6, in this case circular. Similarly, FIGS. 2 and 2A show an example in which there are three tie bars 2, in this case hollow tubes, held in a flange 4, in this case circular. A typical article such as a thin wall container, e.g., a conical cup 6, is shown with its perimeter slightly “squeezed” by the segments 5. FIG. 3 shows the slight squeezing more clearly. Obviously, it is desirable to squeeze the article no more than necessary to temporarily hold it in place, without damaging it or making it too difficult to reposition or remove.

[0024] Thus the radial net distance between the tie bars is defined by the shape of the outer dimensions of the parts to be handled, e.g., the diameter of the rim of a circular lid, minus a little amount defined by the shape of that rim and the flexibility of the material, thus creating sufficient “squeeze” to hold the part in place. In order for the connector flanges/brackets not to hinder to smooth passage of parts through the cage, the defining orifice line in these flanges is broken up by the bores of the tie bars making up the stacking channel or cage. In other words, the perimeters of the tie bars protrude into the area of the main orifices so that the passing parts do not touch the surface of the flange orifices, and smooth passage of the parts is facilitated. By the same token, the tie bars and the connection flanges at the in-feed ends of the cages are tapered for a lead-in.

[0025] FIGS. 4 and 4A show a cage with four tie bars 2 arranged in an asymmetric fashion, holding in place an otherwise possibly unstackable circular closure 10 with a strapped-on lid 11. The bracket 4 in this case is a ring with a cut-out area 14, which allows maintaining the precise orientation of the parts in the stack, and forming the stacks with the lids 11 outside the cage.

[0026] FIGS. 5 and 5A show an otherwise possibly unstackable plastic part in the shape of a rectangular base cover 16 with attached oval top lid 17. The stacker cage is made up by eight tie bars 2, held in space by a C-shaped bracket 4.
7. A stacking system according to claim 3, wherein infeed ends of the tie bars have chamfered lead-ins.

8. A stacking system according to claim 4, wherein infeed ends of the tie bars have chamfered lead-ins.

9. A stacking system according to claim 1, wherein an outfeed end of said cage has at least one tie bar removed, thereby facilitating access for stack removal.

10. A stacking system according to claim 2, wherein an outfeed end of said cage has at least one tie bar removed, thereby facilitating access for stack removal.

11. A stacking system according to claim 3, wherein an outfeed end of said cage has at least one tie bar removed, thereby facilitating access for stack removal.

12. A stacking system according to claim 4, wherein an outfeed end of said cage has at least one tie bar removed, thereby facilitating access for stack removal.

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