equipment of about 50 individual stages, each stage requiring different tooling or "tool groups". The process handling equipment comprises apparatus with at least one rotatable process turret having a number of pockets, each pocket being adapted to support an article. The pockets are divided into groups, with each group of pockets having associated tooling. Although the apparatus also includes a re-phase means to transfer an article from one group of pockets to the next, the pitch of a can is not changed. Instead, the multi-stage process is a system for moving the can one pitch so that the can is presented, say, to the second members of the tool groups on the second recirculation, or third members of the tool groups on the third recirculation (or nth members of the tool groups on the nth recirculation).

[0005] The challenge for a rotary machine infeed system for feeding cans to any container manufacturing process including die necking, is that the machine takes delivery of container bodies which are spaced or "pitched" in a linear fashion, and the infeed system must change the pitch between the container bodies to that of a circular turret - and a larger pitch. The processing pitch may also need to be larger in order to accommodate tools for performing the necking process. The manufacturing process will also have to be carried out at the line speed, often in excess of 1500 containers per minute or greater.

[0006] Each turret on a rotary machine has a number of pockets, each pocket being adapted to receive and retain a containers such as a can body, for example by vacuum. The pockets to carry the can bodies on each circular turret are each separated by a (pocket) pitch. The closer this pocket pitch is to the can body diameter the better the feed onto the infeed turret.

[0007] Embodiments of t~~T~~he present invention seeks to provide an infeed apparatus comprising a series of turrets, which has the facility to change the rotational speed of individual turrets, the turrets having fixed centre distances (between their rotating turret axes) and differing numbers of pockets, so as to be able to deliver cans at discrete circular pitches to a container manufacturing machine.

Summary of invention

[0008] According to a first aspect of the present invention, there is provided in combination, an infeed apparatus and a container processing machine, the infeed apparatus providing containers to a process turret on the container processing machine, the infeed apparatus comprising:
a conveyor for delivering containers at a linear pitch;
an infeed turret for receiving the containers and increasing the pitch of the containers to the circular pitch of the infeed turret; and
a series of at least two further circular turrets which receive and transfer the containers;
wherein:
the exchange ratio from one turret to the next (T5:T4, T4:T3, T3:T2, T2:T1) of the infeed apparatus is discrete and no greater than 2:1.~~an infeed apparatus for providing containers to a process turret on a container processing machine, the apparatus comprising:~~
~~a conveyor for delivering containers at a linear pitch;~~
~~an infeed turret for receiving the containers and increasing the pitch of the containers to the circular pitch of the infeed turret; and~~
~~a series of two or more further circular turrets which receive and transfer the containers;~~
~~characterised in that:~~
~~the final circular turret of the infeed apparatus is adapted to have the same number of pockets as the number of tools per tool group on a subsequent process turret of a container processing machine to which the cans are supplied by the infeed apparatus; and~~
~~the exchange ratio from one turret to the next of the infeed apparatus is discrete and no greater than 2:1.~~

[0009] For the avoidance of doubt, the expression "discrete" is used herein to mean individually distinct. The infeed apparatus in embodiments of the present invention is thus adapted to supply containers to a re-circulating loop of a container processing machine such as that described in EP 1828035 A and changes infeed pocket numbers and speed to deliver the can, subsequently, into the production loop, at the pitch of the first members of the tool group. Through regulating the container pitch, the infeed apparatus facilitates subsequent re-circulation of the containers within the production machine.

[0010] The supply of containers from the conveyor to the first turret of the infeed apparatus may either be constant velocity or tangential to the turret. In one example, the ratio of circular pitch between pockets on a 300mm diameter first turret to the container body diameter or spacing on the linear conveyor may be 1.2 to 1.5 for a tangential infeed turret or 1.8 to 2.6 for a constant velocity (sometimes referred to simply as "CV") infeed. The infeed apparatus uses a series of rotating turrets, which are adapted to transfer the containers and to increase their circular pitch to that of a first process turret on the container processing machine - or some multiple of that process turret circular pitch. Subsequently, the processing turret on a high-

speed machine may operate at a speed of up to 250 rpm for example, using recirculation of containers on the container processing machine in order to achieve the final output of up to 1500 containers (or cans) per minute.

[0011] Preferably, each of the series of turrets of the infeed apparatus has a selected number of pockets which are separated by a specific pitch and the number of pockets on the final turret of the infeed apparatus dictates the number of circulations of the containers on the container processing machine in order to achieve the desired final output.

[0012] The infeed apparatus may use gear and/or servo motor drives to drive rotation of the turrets. The increase in container pitch may thus be achieved either by a change in turret diameter, or by adjusting both the number of turret pockets and the rotational speed of the turret.

[0013] Although it is known to recirculate and re-phase cans in, for example, the can necking machine of EP 1828035 , the Applicant has now discovered that it is possible to re-pitch the linearly delivered containers such as can bodies to a range of circular turret pitches in the infeed apparatus. Re-pitching may be selected according to the number of re-circulations in the can processing machine, not only by fixing the pitch ratio (as noted above) but also by the use of servomotors in the infeed apparatus, which can operate a range of gear ratios for a group of turrets. The advantage of using servomotors is that complex gearboxes or time-consuming manual change gear systems may beare avoided. Servomotor driven turrets realise the facility to change the number of turret pockets and turret speed independently and so deliver the range of circular pitches that are required by the re-circulations of the high-speed machine, which can be used for a variety of containers.

[0014] The infeed apparatus in embodiments of the present invention may thus achieves an increase in container, or can, pitch either by a change in turret diameter, or by adjusting both the number of turret pockets and the rotational speed of the turret.

[0015] The exchange ratio is never more than 2:1 between turrets so as to avoid damaging the can, and the infeed apparatus uses a series of between 3

and 5 turrets. The use of 5 turrets has been shown by the Applicant to give the best flexibility in the infeed apparatus and the attached examples show a series of five turrets in the infeed apparatus.

[0016] Between two and 12 re-circulations in the container processing machine may ~~gives~~ the best results, depending on the type of container supply to the first turret of the infeed apparatus, i.e. tangential or CV. The number of re-circulations also depends on the number of tools per tool group. The number of tool groups is a multiple of the number of pockets on the process turret. The turret pitch ranges obtained may be one of five different pitches, depending on 2, 3, 4, 6 or 12 re-circulations. On the final infeed turret, the number of pockets is the same as the number of tools per tool group on the process turret. The containers formed by the container processing machine may be of the drawn and ironed ("D&I") or extruded types.

[0017] Preferably, cans or other containers are passed from one turret to the next in the infeed apparatus by interfacing turret pockets. This may require trailing edge adjustment in which the trailing edge of one turret extends above its pitch circle diameter and the next turret has a local relief, which allows passage of the extension.

[0018] The final transfer turret of the infeed apparatus, which is adjacent the process turret of the container processing machine, and the process turret itself, are usually driven by the main gear system.

[0019] According to a secondfurther aspect of the present invention, there is provided a method of adjusting container pitch in an infeed apparatus for delivery to a container processing machine, the method comprising:
providing containers separated by a linear pitch;
receiving the containers on an infeed turret (T5) so that the containers are separated by a circular pitch;
passing the containers via a series of further circular turrets (T4, T3, T2, T1) to a container processing machine; and, optionally,
recirculating containers on the container processing machine;
wherein the step of passing the containers in the infeed apparatus uses distinct exchange ratios (T5:T4, T4:T3, T3:T2, T2:T1) between adjacent turrets which are no greater than 2:1.~~for delivery to a container processing~~

~~machine, the method comprising: providing containers separated by a linear pitch;~~

~~receiving the containers on an infeed turret so that the containers are separated by a circular pitch;~~

~~passing the containers via a series of further circular turrets to a container processing machine; and, optionally,~~

~~recirculating containers on the container processing machine;~~

~~characterised in that the step of passing the containers uses distinct exchange ratios between adjacent turrets which are no greater than 2:1.~~