(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 May 2007 (10.05.2007)

PCT

(10) International Publication Number
WO 2007/052012 A2

(51) International Patent Classification:
A61J 3/00 (2006.01)

(21) International Application Number:
PCT/GB2006/004062

(22) International Filing Date: 31 October 2006 (31.10.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0522188.2 31 October 2005 (31.10.2005) GB

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2007/052012 A2

(54) Title: APPARATUS FOR TABLET COATING

(57) Abstract: The present invention relates to apparatus for use in a method of tablet coating, that is coating ingestible tablets with a film. In particular, the invention relates to apparatus for transferring tablets, apparatus for mermoforming a film on at least part of a tablet and apparatus for sealing overlapping film layers formed on a tablet. The present invention also relates to a tablet produced by using the apparatus of the present invention.

Apparatus for Tablet Coating

The present invention relates to apparatus for use in a method of tablet coating, that is coating ingestible tablets with a film. In particular, the invention relates to apparatus for transferring tablets, apparatus for thermoforming a film on at least part of a tablet and apparatus for sealing overlapping film layers formed on a tablet. The present invention also relates to a tablet produced by using the apparatus of the present invention.

Ingestible tablets, for example, of a medicament, vitamin, dietary supplement, etc., are usually coated with an ingestible material so that the tablets are more stable during storage and easier to swallow. The coating also acts as a safeguard against tampering. It is known to enrobe tablets in gelatin for this purpose by dipping tablets into a gelatin solution and allowing the solution to dry to form a coating. Suitable gelatin solutions may be coloured, and it is known to produce dual colour gelatin coatings by coating the entire tablet with a first coloured coating and then, after drying, coating half of the tablet with a differently coloured gelatin. This produces a tamper-evident tablet. Unfortunately this process involves several steps and is time consuming, even with single coating processes, as long drying times are involved. Other problems are also associated with use of gelatin as gelatin is an animal-derived material and there are concerns over contamination of such material, in view of animal related diseases such as Bovine Spongiform Encephalopathy (BSE).

An alternative method for enrobing tablets has been described in US Patent Application US 2004/0161527. In this application, a method of enrobing tablets comprising vacuum forming a film of material onto the surface of a tablet is described. In the method a film is vacuum formed around a first surface of the tablet, excess film is removed, the tablet is turned over and a second film is vacuum formed on the now exposed surface of the tablet so that the tablet is entirely enrobed. Any overlapping layers of film produced by this method are then sealed together with glue applied to at least one of the overlapping surfaces. One of the disadvantages associated with this method is that the method has a number of steps and requires manual turning over of

the tablet to ensure that the entire surface of the tablet is covered by a film. A further disadvantage is that gluing the overlapping film layers together has not always been successful by using the method disclosed. A further disadvantage with this method is that it has been found that the film does not form a particularly tight coating onto the tablet using the vacuum forming process disclosed and that air bubbles become trapped between the film and the tablet.

A number of the disadvantages associated with the prior art method are overcome by using the apparatus of the present invention.

The present invention relates to apparatus which can be used in a process for producing a coated tablet. Each apparatus disclosed herein can be used within a substantially automated process for producing a coated tablet.

Generally, apparatus for performing a substantially automated process for coating a tablet with a film, will comprise:
a first receiver having an aperture for receiving a tablet;
first thermoforming apparatus for thermoforming a first film around the exposed surface of the tablet to form a partially coated tablet;
a first laser for cutting the partially coated tablet from the remainder of the film;
a second receiver having an aperture for receiving the partially coated tablet from the first receiver, wherein the partially coated tablet is positioned in the aperture so that the uncoated part of the tablet and a portion of the coated part of the tablet is exposed;
second thermoforming apparatus for thermoforming a second film around the exposed surface of the partially coated tablet and overlapping part of the first film;
a second laser for cutting the coated tablet from the remainder of the film;
an ironing device having a bore for receiving the coated tablet from the second receiver, wherein the bore is sized to force the first film and the second film into contact where they overlap so that a seal is formed.

According to a first aspect of the present invention, there is provided an apparatus for transferring a tablet between a first and second receiver, the apparatus comprising:

a first receiver comprising a first transfer head positioned within an aperture on a surface of the first receiver that is capable of holding a first side of a tablet, wherein the transfer head can move from a proximal position within the aperture to a distal position where it protrudes from the surface of the first receiver; and

a second receiver comprising a second transfer head positioned within an aperture on a surface of the second receiver that is capable of holding a second side of a tablet,

wherein in use the first transfer head holds the first side of a tablet and moves from a proximal position to a distal position and the second side of the tablet contacts, and is held by, the second transfer head in order to effect transfer of the tablet between the aperture on the first receiver and the aperture on the second receiver.

In the method disclosed in US Patent Application US 2004/0161527, a first side of a tablet is coated when held on a receiver, the tablet is then manually turned over so that the second side of the tablet is coated when held on the receiver. Such manual manipulation of the tablet is very labour intensive and prevents the tablet being coated in an automated process. Furthermore, a high level of accuracy is required when transferring a tablet from a first receiver to a second receiver to ensure that the tablet is in the correct position for the second layer of film to be applied.

By holding the first side of a tablet during the transfer of the tablet from a first receiver to a second receiver, it has been found that the tablet is accurately transferred and correctly positioned on the second receiver.

The apparatus can be used for transferring any tablet from a first receiver to a second receiver.

The second transfer head may, like the first transfer head, be capable of moving from a proximal position within the aperture to a distal position where it protrudes from the surface of the second receiver.

The term "tablet" as used herein means any solid form of medicament, etc., including tablets, caplets, capsules, etc. For simplicity, all such forms are referred to herein as tablets. The tablets can be any suitable shape, including tablets of a circular

symmetrical form with a circular cylindrical side wall, capsule shaped, oblong shaped, lozenge shaped and oval shaped.

As will be appreciated, the first and second transfer heads may, depending on the shape of the tablet, be adapted (i.e., exchanged) to ensure that the first and second side of the tablet can be held.

The first receiver is any support that comprises one or more first transfer heads, wherein each transfer head in the proximal position is positioned within an aperture formed on the surface of the first receiver, allowing a tablet to be held by the first transfer head on the surface of the first receiver so that at least the second side of the tablet is exposed.

The second receiver is any support that comprises one or more second transfer heads, wherein each transfer head is positioned within an aperture formed on the surface of the second receiver, allowing a tablet to be held by the second transfer head on the surface of the second receiver so that at least the first side of the tablet is exposed.

The first and second receiver may be in the form of flat plates or substantially circular rotatable drums wherein the one or more tablets are held on the outer surface of the drums. Preferably the first and second receivers are rotatable drums. It is further preferred that the outside surface of the drum has a plurality of faces e.g., having a plurality of planar faces that extend parallel to the rotational axis of the drum. Each face has an aperture comprising a transfer head or more preferably a row of apertures comprising transfer heads arranged parallel to the rotational axis of the drum. The planar faces ensure that the surface of the receiver adjacent each aperture is flat, which helps with the manufacture of the receivers and with the subsequent thermoforming of a film onto a tablet positioned within the aperture.

The first and second receivers preferably have corresponding positions for holding the one or more tablets. It is further preferred that the first and second receivers are substantially identical so that a tablet on the first receiver can be transferred more accurately to a corresponding position on the second receiver.

It is particularly preferred that the first and second receivers are drums positioned so that at one point on the circumference of the drums only a small gap (about 0.5 to 10 mm) exists between the drums. Placing the drums any closer together can result in difficulties due to the fact that the outside surface of the drums may have a plurality of planar faces. Any tablet having a planar shape held proud of the outside surface of the drum may also prevent the drums being positioned closer together.

Preferably the first and second receivers are each a rotatable drum having a plurality of faces on the outside surface, wherein each face of the drum has an aperture comprising a transfer head or each side has a row of apertures housing transfer heads arranged parallel to the rotational axis of the drum. The drums may have from 6 to 500 faces, preferably from 50 to 200, more preferably from 80 to 120 and most preferably 112 faces. It may also be possible for the plurality of faces on the outside surface of the drums to be interchangeable with other faces so that differently shaped apertures or different arrangements of apertures may be formed on the surface of the drums.

The first and second receivers can be constructed from any suitable material. Preferably, the first and second receivers are constructed from stainless steel.

The first and second transfer heads can be any device capable of holding a side of a tablet. Preferably, the first and the second transfer heads hold the side of the tablet by suction. Each transfer head is therefore preferably connected to a vacuum pump causing a vacuum to be formed at the part of the transfer head that comes into contact with the side of the tablet. The part of the transfer head that comes into contact with the side of the tablet preferably may also comprise a sealing ring (preferably a rubber ring or other suitable sealing ring) sized to assist with forming a vacuum between the side of the tablet and the transfer head, although such a ring is not essential. Transfer heads for holding articles by suction are well known to those skilled in the art.

The first transfer head, and optionally the second transfer head, can move from a proximal position, where they are substantially positioned within the aperture formed in the receiver, to a distal position, where they protrude from the surface of the receiver.

In the proximal position, the transfer head will hold a tablet at the surface of the receiver so that at least 50% of the surface of the tablet is exposed. In the distal position, the transfer head will hold a tablet away from the surface of the receiver. Preferably the first transfer head, and optionally the second transfer head, are connected to the first and second receivers, respectively, via pistons that can extend and retract to move the transfer heads between a proximal and a distal position. Suitable pistons are well known to those skilled in the art.

The piston or pistons are under control so that the tablet is safely transferred between the first and the second receiver. When the apparatus according to the first aspect of the present invention is in use, the first transfer head holds the first side of a tablet and holds the tablet on the first receiver so that the second surface of the tablet is exposed. At this point, the first transfer head is in a proximal position so that the tablet is held on the surface of the first receiver. The first transfer head moves from a proximal position to a distal position so that the second side of the tablet contacts the second transfer head. The second transfer head holds the second side of the tablet. The second transfer head is in a proximal position and the tablet is held on the surface of the second receiver. The tablet is therefore moved from the surface of the first receiver to the surface of the second receiver. The first transfer head stops holding the first side of the tablet and preferably returns to a proximal position.

Alternatively, and when the second transfer head can move from a proximal position to a distal position, the first transfer head holds the first side of a tablet and holds the tablet on the first receiver so that the second surface of the tablet is exposed. At this point, the first transfer head is in a proximal position so that the tablet is held on the surface of the first receiver. The second transfer head is in a distal position and protrudes from the surface of the second receiver and contacts the second side of the tablet, so that the tablet is held by both the first and the second transfer heads. The first transfer head moves from a proximal position to a distal position and the second transfer head simultaneously moves from a distal to a proximal position. The tablet is therefore moved from the surface of the first receiver to the surface of the second receiver. The first transfer head stops holding the first side of the tablet and preferably

returns to a proximal position. Such an arrangement ensures that the first and second transfer heads simultaneously hold the tablet during transfer.

As will be appreciated, the movement of the transfer heads and the holding action of the transfer heads needs to be controlled to ensure that the tablet is correctly transferred. A computer (this term being intended to include any suitable programmable electronic device, including but not limited to personal computers) is preferably used to control the movement of the transfer heads and the holding action of the transfer heads. In particular, the computer controls the vacuum formed in the transfer heads as well as movement of the pistons. Control of the transfer heads will also be referenced to the position of the first and second receivers, so that corresponding first and second transfer heads are at the correct position with respect to each other to co-operate and transfer a tablet between the first and the second receiver.

The first transfer head can additionally be used to obtain a tablet from a tablet feeder. In use, the tablet feeder will display the first side of a tablet so that it can be held by a first transfer head. The first transfer head will be in a distal position and holds the first side of the tablet, and then retract to a proximal position so that the tablet is held on the surface of the first receiver. The tablet feeder can be any suitable tablet feeder that is capable of displaying a first side of a tablet to that it can be held by a first transfer head.

The second transfer head can additionally be used to deliver a tablet to additional apparatus. For example, the additional apparatus may be apparatus for further processing the tablets or may simply be a receptacle. In use the second transfer head will move from a proximal position to a distal position and release its hold on the second surface of the tablet so that the tablet is delivered to the subsequent apparatus.

The apparatus according to the first aspect of the present invention is used to transfer a tablet from a first receiver to a second receiver so that both the first and the second sides of the tablet are exposed enabling the tablet to be coated with a film. In use, when a tablet is held on the first receiver, the exposed second side of the tablet is coated with a film. The partially coated tablet is then transferred via the first and second transfer

heads to the second receiver so that the first side of the tablet is exposed. The exposed first side of the tablet is then coated with a film resulting in a fully coated tablet.

According to a second aspect of the present invention there is provided an apparatus for thermoforming a film on at least part of a tablet comprising:

a receiver for supporting one or more tablets;

a film holder for positioning, in use, a film in registration with the one or more tablets; and

a housing for positioning, in use, on the opposite side of the film to the receiver and connected via the film to the receiver to form an airtight chamber with the film, wherein the housing comprises a heater positioned adjacent to the film and a port connected to a pump allowing positive air pressure to be formed in the chamber,

wherein in use the film is heated until the film is at the correct temperature for thermoforming, and positive pressure produced in the housing causes the film to form around the one or more tablets positioned on the receiver.

In the method disclosed in US Patent Application US 2004/0161527, a film is thermoformed on a tablet. In particular, the tablet is positioned on a receiver and a heated film is drawn onto the tablet by using negative pressure. Basically, a partial vacuum is used to draw the film onto the exposed surface of the tablet. The inventors have found that the film is formed around the exposed surface of the tablet more tightly and more accurately when positive pressure is used to form the film around the tablet. Advantages of forming the film around the tablet more accurately and more tightly, include that the film is less likely to be damaged and that substantially no air or moisture will be present between the tablet and the film. In particular, the use of positive pressure to form the film around the exposed surface of the tablet will substantially reduce the risk of air bubbles being present between the film and the tablet. This will result in the tablet being more stable and thereby having a greater shelf-life.

Thermoforming a film on at least part of a tablet involves heating the film to a desired temperature so that the film becomes deformable so as to be conformable to the external surface of a tablet. Suitable thermoforming films are described in US Patent

Application US 2004/0161527. Preferably the thermoforming film is selected from cellulosics (e.g. hydroxypropylmethylcellulose (HPMC), hydroxypropylcellulose (HPC), hydroxyethylcellulose (HEC), ethylcellulose (EC), methylcellulose (MC), carboxymethylcellulose (CMC) etc), enteric polymers e.g. HPMC-AS (acetate sucinate), HPMC-P (Phthalate), and others such as polyvinyl alcohol (PVOH), polyethylene oxide (PEO), PVOH-PEG graft copolymers, alginates, pullulan, pectin or derivatives of the above.

The film is formed on at least part of the tablet. Preferably the film is formed on at least 50% of the tablet, so that on turning over the tablet and forming the film on the other side of the tablet, the tablet is fully coated. It is particularly preferred that when 2 or more films are applied to the tablet the films overlap to provide a seal.

The receiver for supporting one or more tablets can be any suitable receiver that allows at least part of the tablet to be exposed. Preferably the receiver allows over 50% of the tablet to be exposed. The receiver may be of the type disclosed in US Patent Application US 2004/0161527 or may be the first and second receiver described above with respect to the first aspect of the present invention.

The apparatus according to the second aspect of the present invention comprises a film holder for positioning in use a thermoforming film in registration with one or more of the tablets. The film holder may be any device that holds the film in position so that it can be formed around the one or more tablets by the application of positive pressure. Preferably, the film holder is a frame that holds the film in position.

The apparatus according to the second aspect of the present invention comprises a housing that is positioned on the opposite side of the film to the receiver. The housing is connected to the receiver via the film and forms a sandwich with the film held in-between the housing and the receiver. An airtight chamber is formed by the film and the housing. Suitable seals positioned on the housing and the receiver can be used to assist with forming the necessary air tight seal.

The housing also comprises a heater positioned adjacent to the film enabling the film to be heated to a suitable temperature for thermoforming around one or more tablets. The heater may be an infra red heater, infrared lamps, a heated plate, a hot air source, etc. Preferably the heater is a heated plate.

The housing has a port connected to a pump allowing positive air pressure to be formed in the chamber. Preferably, the pump also allows negative pressure to be formed in the chamber.

The heater may be positioned so that it is capable of heating the adjacently positioned film. Alternatively, by producing negative pressure in the housing, the film will move towards, or come into contact with, the heater and cause the film to be heated to the correct temperature for thermoforming more quickly.

In use, the film is heated to the correct temperature for thermoforming and positive pressure is produced in the chamber causing the film to form around the one or more tablets. Negative pressure may be also be produced by the receiver to further increase the total pressure forcing the film around the one or more tablets. The use of negative pressure in combination with positive pressure has the advantage that the conformation of the film around the surface of the tablet is improved. In particular, in tablets containing embossing, the conformation of the film around the embossed shapes or indicia is assisted and the probability of bridging of entagliations is reduced.

The term "positive pressure" means pressure that is above atmospheric pressure. Preferably, the positive pressure produced in the chamber is at least 150kPa, more preferably at least 300kPa, even more preferably between 300kPa and 600kPa, most preferably between 300kPa and 500kPa.

The term "negative pressure" means pressure that is below atmospheric pressure. Preferably the negative pressure produced in the chamber is between about 10kPa to 90kPa. Preferably the negative pressure produced in the chamber is about 20kPa to 50kPa or about 40kPa to 70kPa.

US patent application US 2004/0161527 discloses a method of coating a tablet using negative pressure only. A problem is that it is very difficult to produce suitable negative pressures. However, it is relatively easy to produce positive pressure up to about 600kPa. Accordingly, by using positive pressure, greater force can be used to form the film around the surface of a tablet.

The housing is preferably constructed so that the force of the positive air pressure is evenly spread over the surface of the film thereby ensuring that the film is uniformly formed around the one or more tablets. In one particular embodiment, the housing comprises a heated plate having a plurality of holes allowing pressurised air to be forced through the holes to move the film into contact with the one or more tablets and to form the film around the exposed surface of the tablets. It is particularly advantageous for the holes to be positioned so that they are not aligned with the one or more tablets but with the interstitial spaces between the one or more tablets. An advantage of such an alignment is that any areas of particularly high air pressure produced directly below each hole will be directed to areas of the film that are not coated onto the tablets, namely the interstitial areas. Preferably the holes are evenly spaced.

It is preferred that the apparatus according to the second aspect of the present invention is used to coat a plurality of tablets simultaneously using a large sheet of film.

Adhesive material may be applied to the surface of the tablets prior to coating with the film. The application of an adhesive to the surface of the tablet is described in US patent application US 2004/0161527.

According to a third aspect of the present invention, there is provided apparatus for sealing overlapping film layers formed on a tablet comprising:
one or more open ended bores for receiving one or more tablets having overlapping film layers, each bore having an internal wall;
a heater for ensuring that at least part of the internal wall of each bore is heated; and
one or more pistons for pushing a tablet through the bore,

wherein on pushing a tablet through the bore the overlapping film layers are pushed together and form a seal by coming into contact with the heated internal wall of the bore.

In the method disclosed in US Patent Application US 2004/0161527, a film is thermoformed on a first side of a tablet and on a second side of the tablet, so that the film layers overlap. It has been found that in order for the overlapping layers of film to be reliably sealed together it is necessary to heat the overlapping layers of film and push them together so that a seal is formed. As indicated in US Patent Application US 2004/0161527 adhesive can be provided between the overlapping films to assist with forming the seal; however, it has been found that it is still necessary to heat the film layers and push them together to reliably form a seal between the overlapping films. The apparatus according to the third aspect of the present invention allows a seal to be formed between the overlapping layers of film in an automated procedure.

The internal wall of the one or more bores can be heated by any suitable heater.

The apparatus preferably comprises a heated block comprising one or more bores extending through the block. The only parts of the block that need to be heated are those parts that come into contact with the one or more tablets, namely the internal walls of the one or more bores. The block may be heated in any suitable manner, e.g., by heated water passing through channels formed in the block, by heating elements embedded in the block, etc. The block may be constructed from any suitable material. Preferably the block is constructed from metal, most preferably stainless steel.

The one or more bores are sized to receive the one or more tablets and to force together the overlapping film layers of the one or more tablets along at least part of the length of the bore. Preferably, the bore tapers so that only on pushing a tablet through the bore the overlapping film layers are forced together. Preferably, each bore is about 1 to 5cm in length, more preferably about 1 to 2cm in length.

The apparatus according to the third aspect of the present invention comprises one or more pistons for pushing a tablet through the one or more bores. The one or more

pistons preferably have a head that can hold the tablet so that the sides of the tablet where the overlapping edges of film are positioned will come into contact with the internal wall of the bore. It is important that the tablet is held in the correct orientation as it is pushed through the bore so that all areas of the tablet having overlapping edges of film come into contact with the internal wall thereby forming a seal between the overlapping films. Preferably the piston is substantially identical to the first and second transfer heads described above with respect to the first aspect of the present invention. In particular, the piston has a head capable of holding a tablet. Preferably, the head holds the tablet by suction. Each head is therefore preferably connected to a vacuum pump causing a vacuum to be formed at the part of the head that comes into contact with the tablet. The part of the head that comes into contact with the tablet may also comprise a sealing ring sized to assist with forming a vacuum between the tablet and the head. Heads for holding articles by suction are well known to those skilled in the art.

The piston moves a tablet through the bore by holding the tablet and then pushing it through the bore. Suitable pistons are well known to those skilled in the art.

The one or more pistons are under control so that the tablet is pushed through the bore at a correct rate to allow the overlapping layers to form a seal. In some embodiments, it may be desirable to allow the tablet to be stationary within the bore for a period of time necessary to allow the seal to form before the tablet is pushed through the bore.

As will be appreciated, the movement of the pistons and the holding action of the heads needs to be controlled to ensure that the tablet is correctly pushed through the one or more bores. A computer is preferably used to control the movement of the pistons and the holding action of the heads. It is particular preferred that a computer controls the vacuum formed in the transfer heads as well as movement of the pistons.

As will be appreciated by those skilled in the art the apparatus of the first, second and third aspects of the present invention may be combined together to form apparatus for coating a tablet with a film. Such apparatus would allow the automated production of coated tablets. Such apparatus would additionally require the presence of cutting

apparatus for cutting the coated or partially coated tablets from the remainder of the film. Such cutting apparatus may simply be a blade shaped to accurately cut the tablet from the film. However, the problem with such blades is that they will dull with time and need to be changed regularly. Furthermore, if the shape of the tablet changes, then different blades will need to be used. Preferably the cutting apparatus is one or more lasers that accurately cut the tablets from the film. Suitable lasers are well known to those skilled in the art. Lasers will have the advantage of not dulling with use and being adjustable so that any shaped tablet can be cut from the film.

The present invention additionally provides the use of the apparatus according to the first aspect of the present invention for transferring one or more tablets between a first and a second receiver.

The present invention additionally provides the use of the apparatus according to the second aspect of the present invention for thermoforming a film on at least part of a tablet.

The present invention additionally provides the use of the apparatus according to the third aspect of the present invention for sealing overlapping film layers formed on a tablet.

The present invention also provides a coated tablet produced by using the apparatus according to the second aspect of the present invention. Such a tablet will have a film tightly formed around at least part of the tablet. Preferably, the tablet will have a film tightly formed around all of the tablet.

The present invention also provides a coated tablet produced by using the apparatus according to the third aspect of the present invention. Such a tablet will have a strong seal formed between the overlapping layers of film.

The present invention also provides a machine comprising the apparatus according to the first, second and third aspects of the present invention, wherein the machine allows the automated production of coated tablets. The machine comprises:

apparatus for transferring a tablet from a first receiver to a second receiver according to the first aspect of the present invention;

first thermoforming apparatus according to the second aspect of the present invention for thermoforming a first film around the exposed surface of a tablet held on the surface of the first receiver to form a partially coated tablet;

a first laser for accurately cutting the partially coated tablet from the remainder of the film;

the second receiver having an aperture for receiving the partially coated tablet from the first receiver, wherein the partially coated tablet is positioned in the aperture so that the uncoated part of the tablet and a portion of the coated part of the tablet is exposed;

second thermoforming apparatus according to the second aspect of the present invention for thermoforming a second film around the exposed surface of the partially coated tablet and overlapping at least part of the first film;

a second laser for accurately cutting the coated tablet from the remainder of the film;

apparatus according to the third aspect of the present invention for sealing overlapping edges of film on the tablet.

The present invention is now described by way of example only with reference to the following Figures.

Figure 1 shows a schematic diagram of an automated apparatus for producing coated tablets.

Figure 2 shows a schematic diagram of part of the apparatus for transferring a tablet from a first receiver to a second receiver using a first method.

Figure 3 shows a schematic diagram of part of the apparatus for transferring a tablet from a first receiver to a second receiver using a second method.

Figure 4 shows schematically apparatus for thermoforming a film on at least part of a tablet.

Figure 5 shows schematically a part of the apparatus for sealing overlapping layers of film formed on a tablet.

EXAMPLES

The present application relates to apparatus for transferring a tablet from a first receiver to a second receiver, apparatus for thermoforming a film on a tablet, and apparatus for sealing overlapping layers of film formed on a tablet. These 3 separate items of apparatus can be combined together into one machine. Such a machine is shown schematically in Figure 1, wherein the machine (1) comprises a first receiver (3), a second receiver (5), first and second thermoforming apparatus (7, 9) for thermoforming a film (4) onto a tablet (2), a tablet feeder (11), first and second cutting lasers (13, 15) and an ironing device (17). The first and second receivers (3, 5) are substantially identical drums, wherein the surface of the drum comprises rows of apertures arranged parallel to the longitudinal axis of the drum for receiving tablets (2). Each row of apertures is formed in a planar strip positioned parallel to the longitudinal axis of the drum, so that the surface adjacent to each aperture is flat (not shown in the Figure). Accordingly, each drum has an outer surface comprising a number of flat faces corresponding to the number of rows of apertures.

In use, a row of tablets (2) is presented to the first receiver (3) by the tablet feeder (11). Each aperture (18) on the first receiver (3) comprises a first transfer head (19) that can move from a proximal position within the aperture (18) to a distal position where it protrudes from the surface of the first receiver (3). The structure of the first transfer head is shown in Figure 2 and Figure 3. The first transfer head (19) moves into a distal position and holds a tablet (2) presented by the tablet feeder (11). The first transfer head (19) then moves to the proximal position so that the tablet (2) is held on the surface of the first receiver (3).

Each first transfer head (19) is shaped to hold a first side of the tablet (2) and holds the first side of the tablet (2) by suction. Each first transfer head (19) can reversibly be connected to a vacuum pump allowing the transfer head (19) to hold the tablet.

The first and second receivers (3, 5) rotate around their longitudinal axis in opposite directions. In Figure 1, the first receiver (3) rotates in an anti-clockwise direction and the second receiver (5) rotates in a clockwise direction.

The row of tablets (2) held on the first receiver (3) move from the tablet feeder (11) to the first thermoforming apparatus (7). Details of the thermoforming apparatus (7) are shown in Figure 4. The first thermoforming apparatus (7) comprises a film holder (not shown) for positioning a film (4) above the tablets (2) held on the surface of the first receiver (3), a housing (21) comprising a heater (24), wherein the housing is positioned on the opposite side of the film (4) to the first receiver (3) and connected via the film (4) to the first receiver (3) to form an air tight chamber (25) with the film (4). The housing has a port (27) connected to a pump (not shown) that can produce positive and negative pressure in the chamber (25). The film used is a HPMC film comprising 77% by weight HPMC and 23% by weight lactic acid plasticiser.

The heater (24) has a plurality of holes (23) allowing air to move through the heater.

In use, the pump is used to produce negative air pressure in the chamber (25) causing the film (4) to come into contact with the heater (24). Once the film (4) is heated to the correct temperature for thermoforming (generally about 5 seconds) the pump produces 300kPa of positive air pressure in chamber (25) and the film (4) becomes detached from the heater (24) and in its heat-softened condition is forced onto the exposed surface of the tablets (2). The use of positive pressure strongly forces the film around the contours of the tablets (2) and ensures that no air bubbles become trapped between the film (4) and the exposed surface of the tablets (2).

The position of the plurality of holes (23) in the heater (24) is such that only interstitial space between the tablets directly underlies the holes. Accordingly, if any extra air pressure is formed directly under the holes (23), this will not affect the uniform nature of the film coating applied to the tablets (2). Instead any extra air pressure will be directed at the interstitial space of the film (4), which will subsequently be discarded.

Once the film (4) has been formed around the exposed surface of the tablets (2) (generally about 6 seconds), the air pressure in the chamber (25) is returned to normal (atmospheric pressure) and the housing (21) is disconnected from the first receiver (3).

The tablets (2) will then be cut from the excess film (4a) using lasers (13). Standard laser cutting techniques can be used to cut the tablets (2) from the excess film (4a). The upper surface of the tablet and part of the side wall of the tablet is coated with the film (4) to a point slightly below the central plane of the tablet (2) so that when a layer of film (4) is formed on the opposite side of the tablet (2), there will be a region of overlap formed by the films (4).

The partially coated tablets (2) held on the first receiver (3) are transferred to the second receiver (5) by transfer apparatus shown partially in Figure 2 and Figure 3. In particular, the partially coated tablets (2) held on the first receiver (3) are transferred to the second receiver (5) by the co-operation of the first transfer heads and second transfer heads (29). Second transfer heads are identical to the first transfer heads and are positioned within the apertures (18) formed on the second receiver (5).

The first receiver (3) and the second receiver (5) are positioned so that the surfaces of the first receiver (3) and the second receiver (5) are positioned closely and are in register with each other so that apertures (18) on the first receiver (3) and on the second receiver (5) directly line up with each other at the closest point between the surface of the first and second receivers (3, 5). The partially coated tablets are transferred at the point when the partially coated tablets (2) on the first receiver (3) are at the closest position to the surface of the second receiver (5).

According to a first method, the partially coated tablets (2) are transferred by the first receiver head (19) moving from a proximal position to a distal position so that the coated surface of the tablet (2) contacts and is held by the second receiver head (29) (see Figures 2a and 2b), said second receiver head (29) being in a proximal position. The tablet (2) is now held on the surface of the second receiver (5) and is held by both the first and second receiver heads (19, 29). The first receiver head (19) releases its hold on the tablet and moves from a distal position to a proximal position (see Figures

2b and 2c). The co-operation between the heads results in the accurate transfer of the tablet (2).

According to a second method, the partially coated tablets (2) are transferred by the second receiver head (29) moving from a proximal position to a distal position where it contacts and holds the coated surface of the tablet (2) (see Figures 3a and 3b). The tablet (2) at this point is held by both the first and the second receiver heads (19, 29). The first receiver head (19) moves from a proximal position to a distal position and the second receiver head (29) simultaneously moves from a distal position to a proximal position. The tablet (2) is now held on the surface of the second receiver (5) and is still held by both the first and second receiver heads (19, 29) (see Figure 3c). The first receiver head (19) releases its hold on the tablet and moves from a distal position to a proximal position (see Figure 3d). The co-operation between the first and second receiver heads (19, 29) results in the accurate transfer of the tablet (2) from the first receiver (3) to the second receiver (5).

The excess film (4a) present on the first receiver is discarded.

The tablet (2) held on the second receiver (5) moves to the second thermoforming apparatus (9). The second thermoforming apparatus (9) is identical to the first thermoforming apparatus (7) and operates in the same way to form a film on the exposed surface of the film.

The tablets (2) will then be cut from the excess film (4a) using lasers (15) and the excess film (4a) is discarded as indicated above. The coated tablets (2) remain on the second receiver (5).

As more than 50% of the tablet (2) is exposed during each of the thermoforming stages, the tablet (2) has a circumferential overlap of film (4).

In order to form a good seal between the overlapping layers of film (4), the tablets (2) are transferred to apparatus for sealing overlapping layers of film formed on the tablet together (17). The sealing apparatus comprises a heated block (31) in the form of a

rotatable drum (see Figure 5). The heated block (31) has rows of bores (33), wherein the opening (35) of the bores (33) are arranged to match the arrangement of apertures (18) on the second receiver (5) to allow easy transfer of the tablets (2) from the second receiver (5) to the bores (33). The sealing apparatus (17) also comprises a series of pistons (37) that push the tablets (2) through the bores (33).

The second receiver (5) and the heated block (31) are positioned so that the surfaces of the second receiver (5) and the heated block (31) are positioned closely and are in register with each other so that apertures (18) on the second receiver (5) and the bore openings (35) on the heated block (31) directly line up with each other at the closest point between the surface of the second receiver (5) and the heated block (31). The coated tablets (2) are transferred at the point when the coated tablets (2) on the second receiver (3) are at the closest position to the surface of the heated block (31).

In use, a coated tablet (2) held on the second receiver (5) is transferred to the opening of a bore (35) on the heated block (31) by the second receiver head (29) moving from a proximal position to a distal position where the tablet (2) is positioned within the opening of the bore (35). The second receiver head (29) releases its hold on the tablet (2) and returns to a proximal position (see Figure 5a).

The heated block (31) rotates anti-clockwise and the tablet within the opening of the bore (35) is contacted by a piston (37). The piston is substantially identical to the first and second receiver heads (19, 29) and the end of the piston (37) holds the tablet (2) by using suction. The piston (37) then pushes the tablet through the bore (33) (see Figure 5b). The bore (33) is tapered to a size that ensures that the overlapping film layers come into contact with the heated wall of the bore (33) and are forced together. The heat from the bore wall as well as the pressure forcing the film layers together ensures that a good seal is formed between the film layers.

Once the tablet (2) exits the bore (33), it is fully coated and a good seal is formed between the overlapping layers of film.

Adhesive may be positioned between the overlapping layers of film to assist with forming the seal.

As will be apparent to those skilled in the art numerous modification can be made to the apparatus described above. Such modifications are considered to be part of the scope of the present invention which is defined in the appended claims.

All documents cited above are incorporated herein by reference.

Claims

1. Apparatus for transferring a tablet between a first and second receiver, the apparatus comprising:

a first receiver comprising a first transfer head positioned within an aperture on a surface of the first receiver that is capable of holding a first side of a tablet, wherein the transfer head can move from a proximal position within the aperture to a distal position where it protrudes from the surface of the first receiver; and

a second receiver comprising a second transfer head positioned within an aperture on a surface of the second receiver that is capable of holding a second side of a tablet, wherein in use the first transfer head holds the first side of a tablet and moves from a proximal position to a distal position and the second side of the tablet contacts, and is held by, the second transfer head, in order to effect transfer of the tablet between the aperture on the first receiver and the aperture on the second receiver.

2. The apparatus according to claim 1, wherein the first and second receivers are substantially identical.

3. The apparatus according to claim 1 or claim 2, wherein the first and second receivers are substantially circular rotatable drums.

4. The apparatus according to claim 3, wherein the first and second receivers have a plurality of planar faces that extend parallel to the rotational axis of the drum.

5. The apparatus according to claim 4, wherein each planar face comprises a row of apertures housing a transfer head.

6. The apparatus according to any one of claims 3 to 5, wherein the drums are positioned so that at one point on the circumference of the drums a gap of between 0.5 and 10mm exists between surfaces of the drums.

7. The apparatus according to any one of the preceding claims, wherein the first and second transfer heads hold a side of a tablet by suction.

8. The apparatus according to any one of the preceding claims, wherein in the proximal position, the first and second transfer heads hold a tablet at the surface of the first or second receiver, respectively, so that at least 50% of the surface of the tablet is exposed.

9. The apparatus according to any one of the preceding claims, wherein the first and second transfer heads are connected to the first and second receivers, respectively, via pistons that can extend and contract to move the transfer heads between a proximal and a distal position.

10. The apparatus according to any one of the preceding claims, wherein the movement and holding action of the first and second transfer heads is controlled by a computer.

11. Apparatus for thermoforming a film on at least part of a tablet comprising:
a receiver for supporting one or more tablets;
a film holder for positioning, in use, a film in registration with the one or more tablets; and
a housing for positioning, in use, on the opposite side of the film to the receiver and connected via the film to the receiver to form an airtight chamber with the film, wherein the housing comprises a heater positioned adjacent to the film and a port connected to a pump allowing positive and negative air pressure to be formed in the chamber,
wherein in use negative pressure in the housing causes the film to come into contact with the heater until the film is at the correct temperature for thermoforming, and positive pressure produced in the housing causing the film to detach from the heater and to form around the one or more tablets positioned on the receiver.

12. The apparatus according to claim 11, wherein in use the film is formed on at least 50% of the surface of the tablet.

13. The apparatus according to claim 11 or claim 12, wherein the heater is a heated plate.

14. The apparatus according to any one of claims 11 to 13, wherein the pump can produce positive and negative pressures in the chamber.

15. The apparatus according to any one of claims 11 to 14, wherein the pump produces at least 150kPa.

16. The apparatus according to any one of claims 11 to 14, wherein the pump produces at least 300kPa.

17. The apparatus according to claim 14, wherein the pump produces from about 10 to 90kPa.

18. The apparatus according to claim 1, wherein the heater is a heated plate having a plurality of holes, which allow pressurised air to pass through the heated plate and, in use, move the film into contact with the one or more tablets.

19. The apparatus according to claim 18, wherein the holes are aligned with the interstitial spaces between the one or more tablets.

20. Apparatus for sealing overlapping film layers formed on a tablet comprising:
one or more open ended bores for receiving one or more tablets having overlapping film layers, each bore having an internal wall;
a heater for ensuring that at least part of the internal wall of each bore is heated; and
one or more pistons for pushing a tablet through the bore,
wherein on pushing a tablet through the bore the overlapping film layers are pushed together and form a seal by coming into contact with the heated internal wall of the bore.

21. The apparatus according to claim 20, which comprises a heated block comprising one or more bores extending through the block.

22. The apparatus according to claim 20 or claim 21, wherein, the one or more bores taper so that on pushing a tablet through the bore the overlapping film layers are forced together.

23. The apparatus according to any one of claims 20 to 22, wherein each bore is about 1 to 5cm in length.

24. The apparatus according to any one of claims 20 to 23, wherein the one or more pistons have a head that can hold the tablet so that the sides of the tablet where the overlapping edges of film are positioned will come into contact with the internal wall of a bore.

25. The apparatus according to claim 24, wherein the head holds the tablet by suction.

26. The apparatus according to any one of claims 20 to 25, wherein the one or more pistons are under control so that the tablet is pushed through the bore at a correct rate to allow the overlapping layers to form a seal.

27. The apparatus according to any one of claims 20 to 26, wherein a computer controls the movement of the pistons and the holding action of the heads.

28. Use of the apparatus according to any one of claims 1 to 10 for transferring one or more tablets between a first and a second receiver.

29. The use of the apparatus according to any one of claims 11 to 19 for thermoforming a film on at least part of a tablet.

30. The use of the apparatus according to any one of claims 20 to 26 for sealing overlapping film layers formed on a tablet.

31. A coated tablet produced by using the apparatus according to any one of claims 11 to 19.

32. A coated tablet produced by using the apparatus according to any one of claims 20 to 26.

33. A machine comprising:

apparatus for transferring a tablet from a first receiver to a second receiver according to any one of claims 1 to 10;

first thermoforming apparatus according to any one of claims 11 to 19 for thermoforming a first film around the exposed surface of a tablet held on the surface of the first receiver to form a partially coated tablet;

a first laser for accurately cutting the partially coated tablet from the remainder of the film;

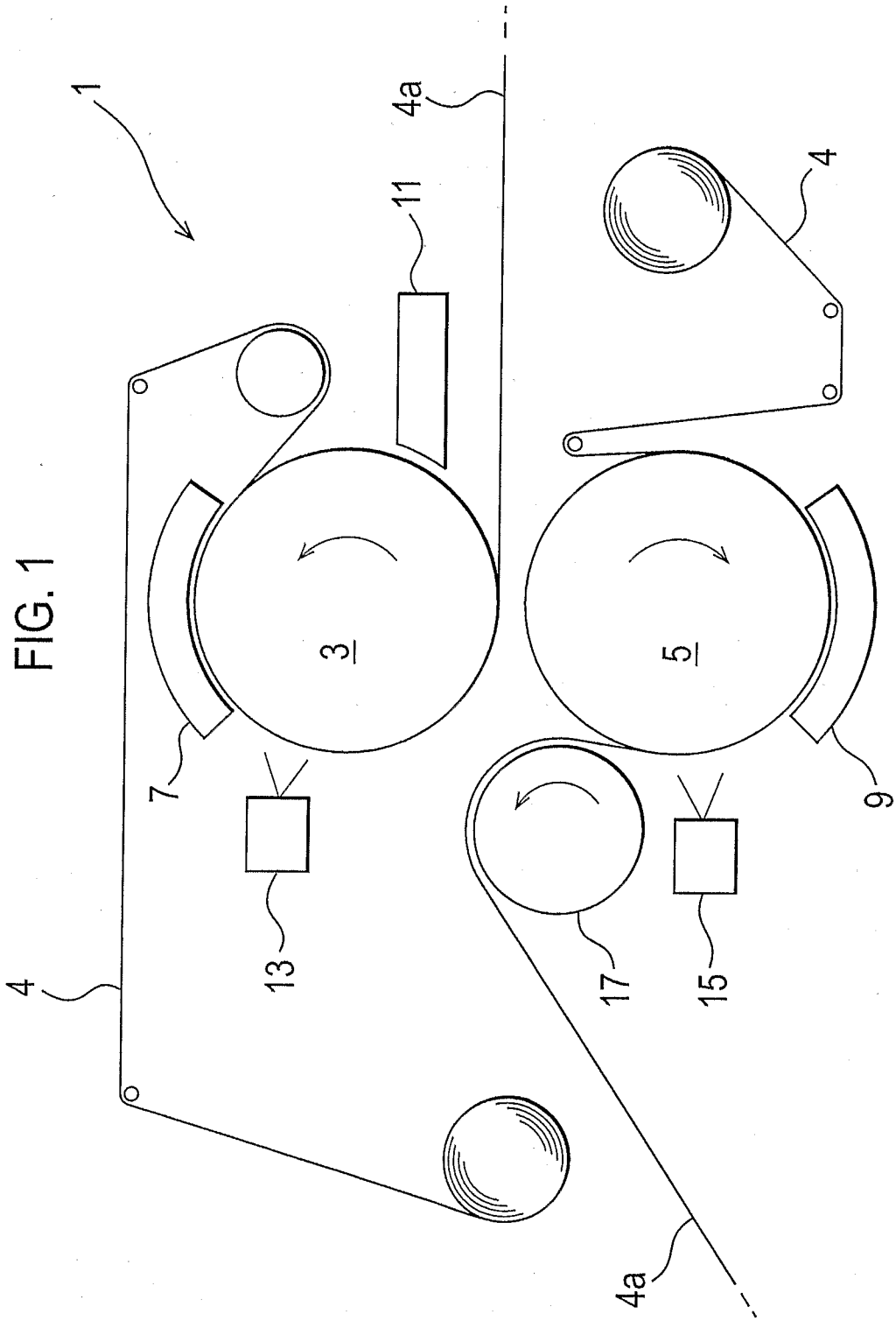
the second receiver having an aperture for receiving the partially coated tablet from the first receiver, wherein the partially coated tablet is positioned in the aperture so that the uncoated part of the tablet and a portion of the coated part of the tablet is exposed;

second thermoforming apparatus according to any one of claims 11 to 19 for thermoforming a second film around the exposed surface of the partially coated tablet and overlapping at least part of the first film;

a second laser for accurately cutting the coated tablet from the remainder of the film;

apparatus according to any one of claims 20 to 26 for sealing overlapping edges of film on the tablet.

FIG. 1



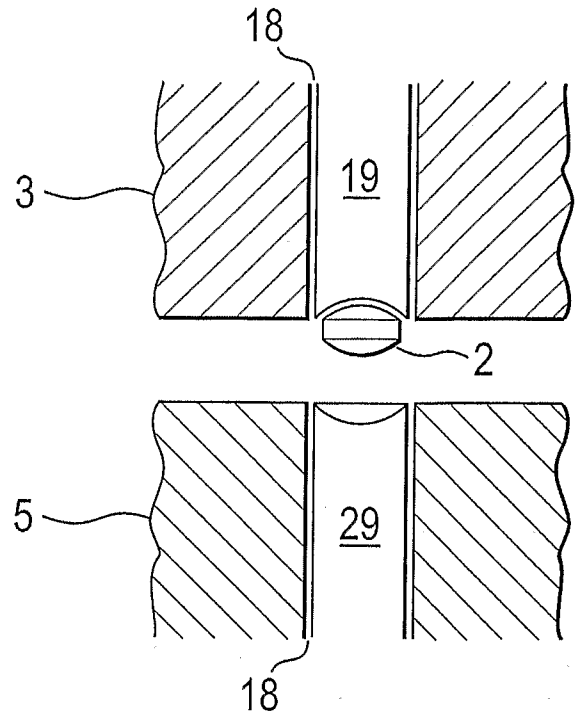


FIG. 2a

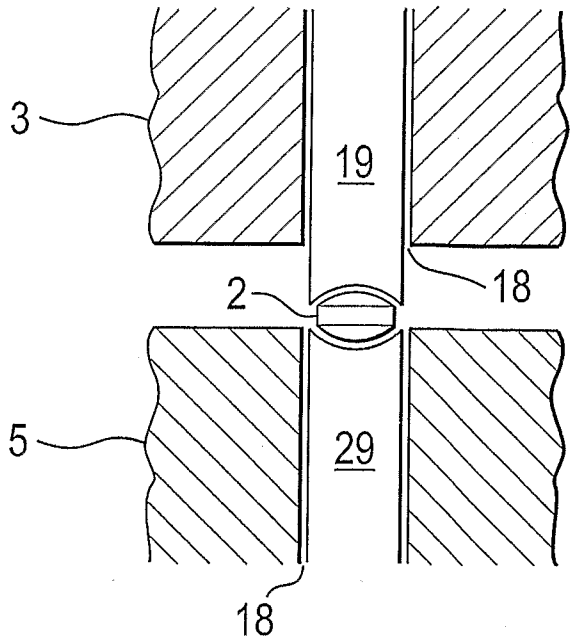


FIG. 2b

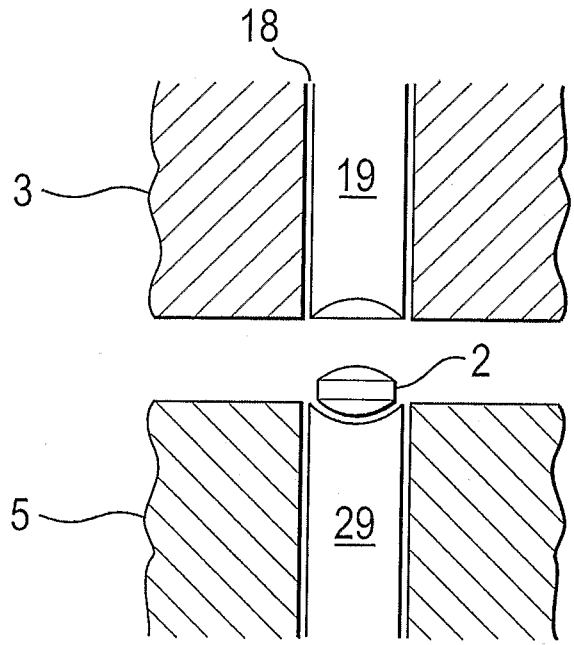


FIG. 2c

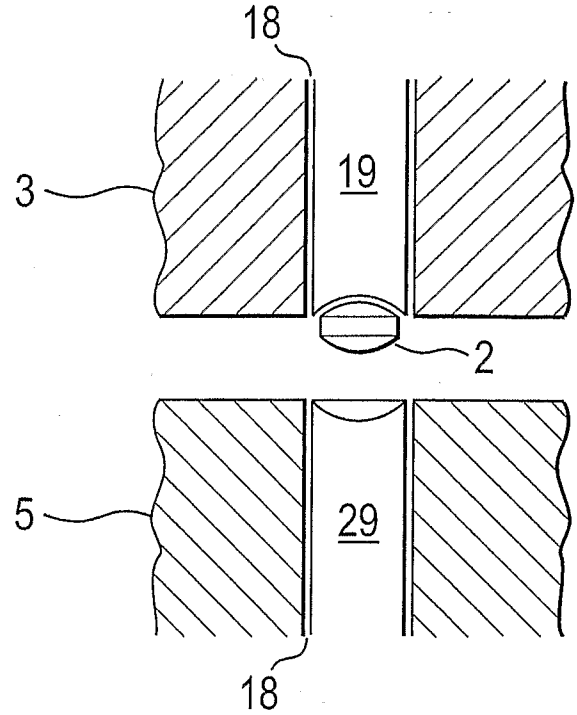


FIG. 3a

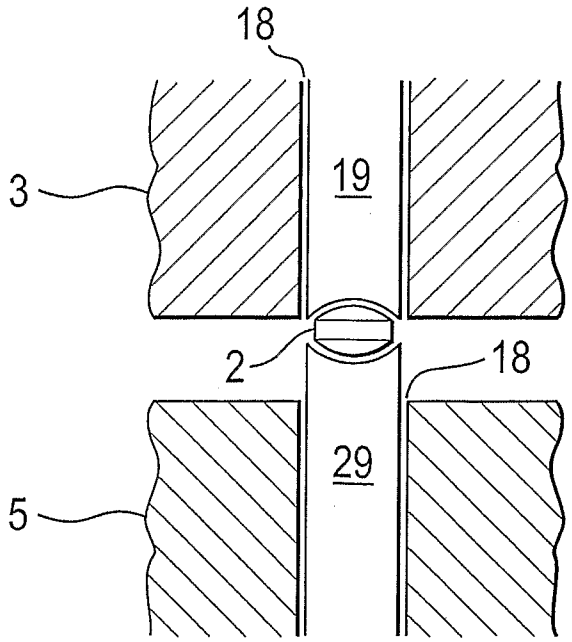


FIG. 3b

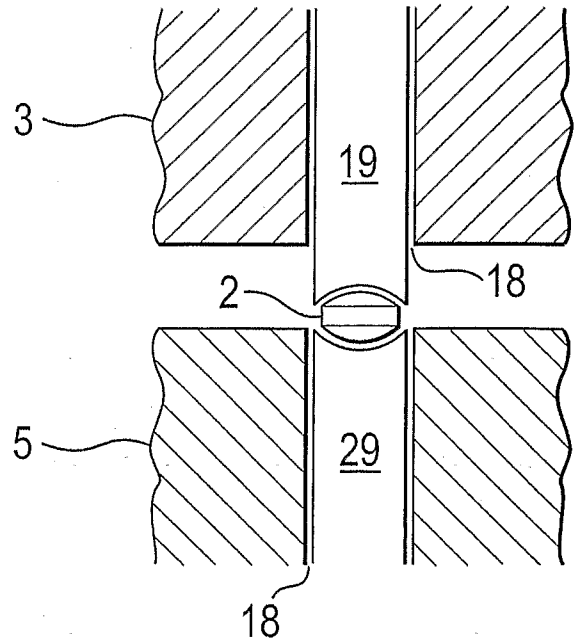


FIG. 3c

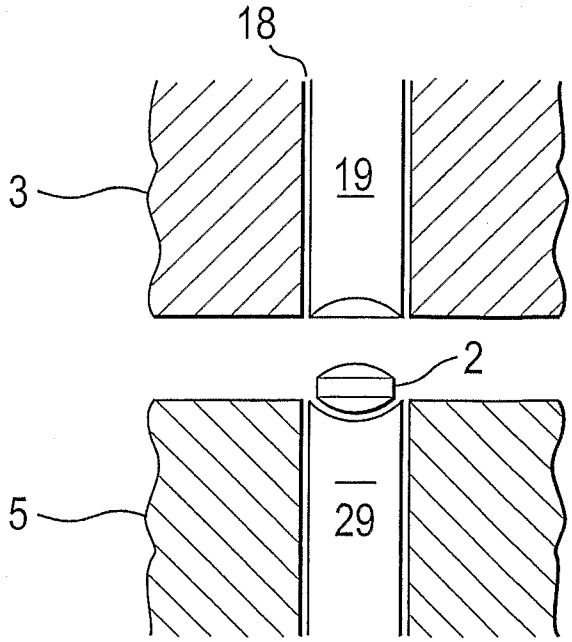
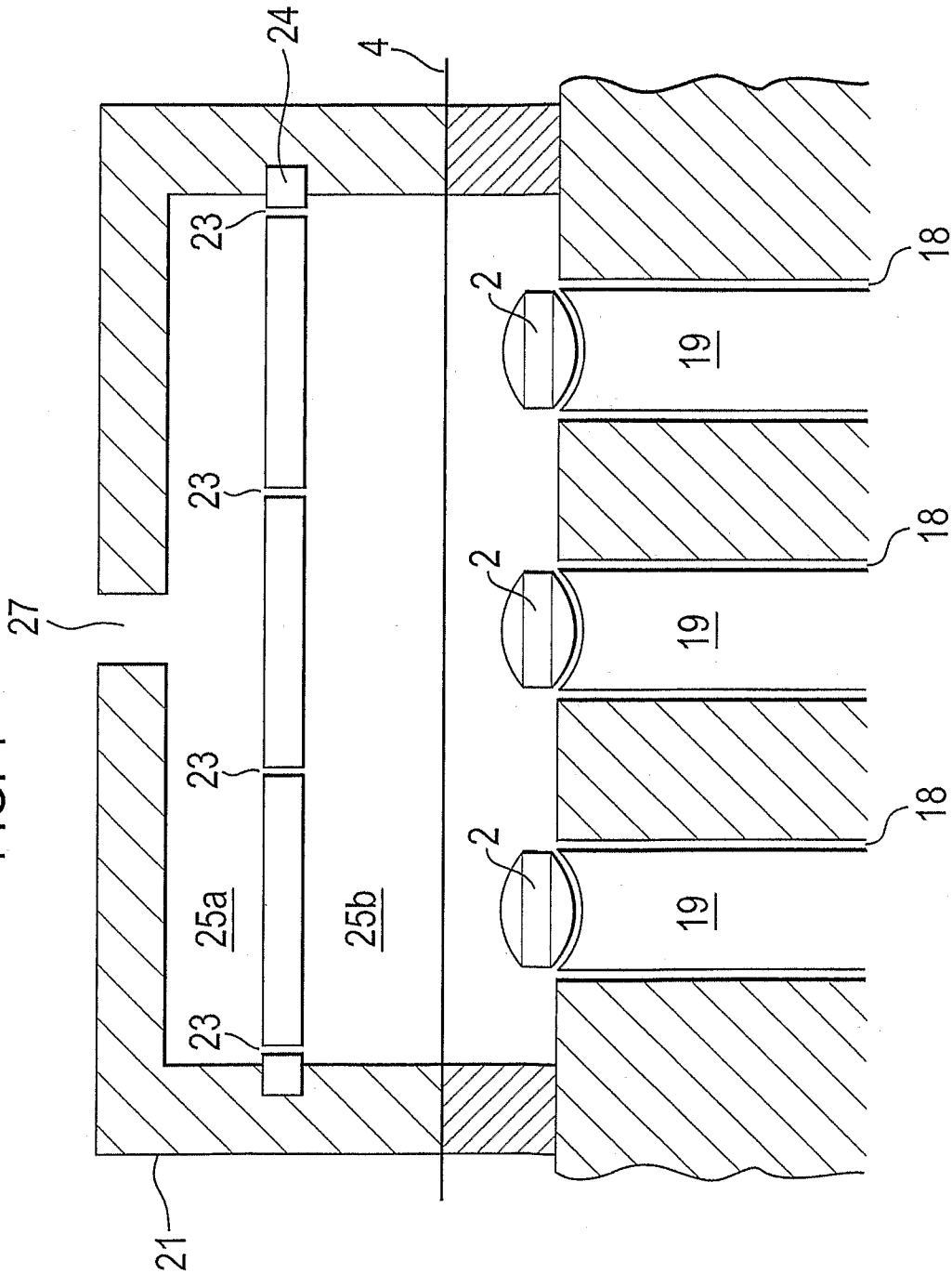


FIG. 3d

FIG. 4



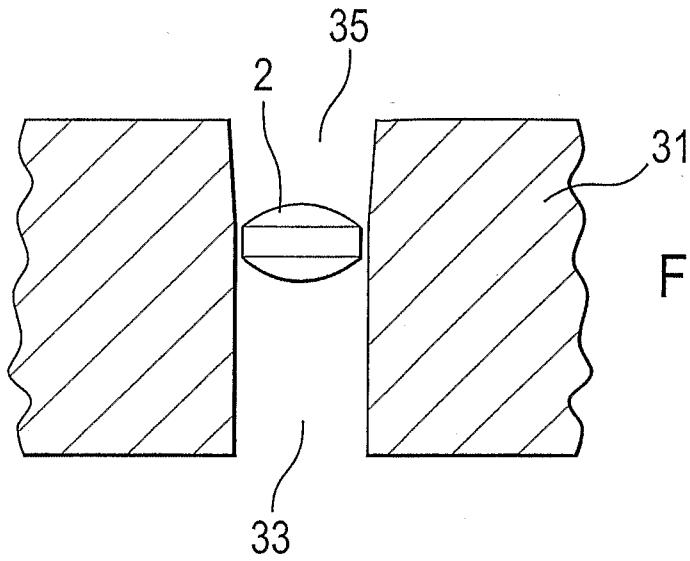


FIG. 5a

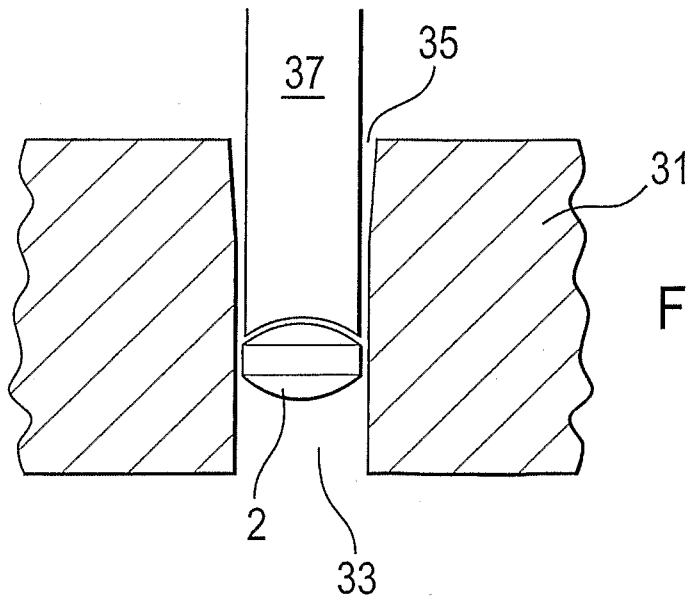


FIG. 5b