Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2531035 C 2009/03/10

(11)(21) 2 531 035

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2005/12/19

(41) Mise à la disp. pub./Open to Public Insp.: 2006/06/30

(45) Date de délivrance/Issue Date: 2009/03/10

(30) Priorités/Priorities: 2004/12/30 (US60/640605);
2005/09/02 (US11/219411)

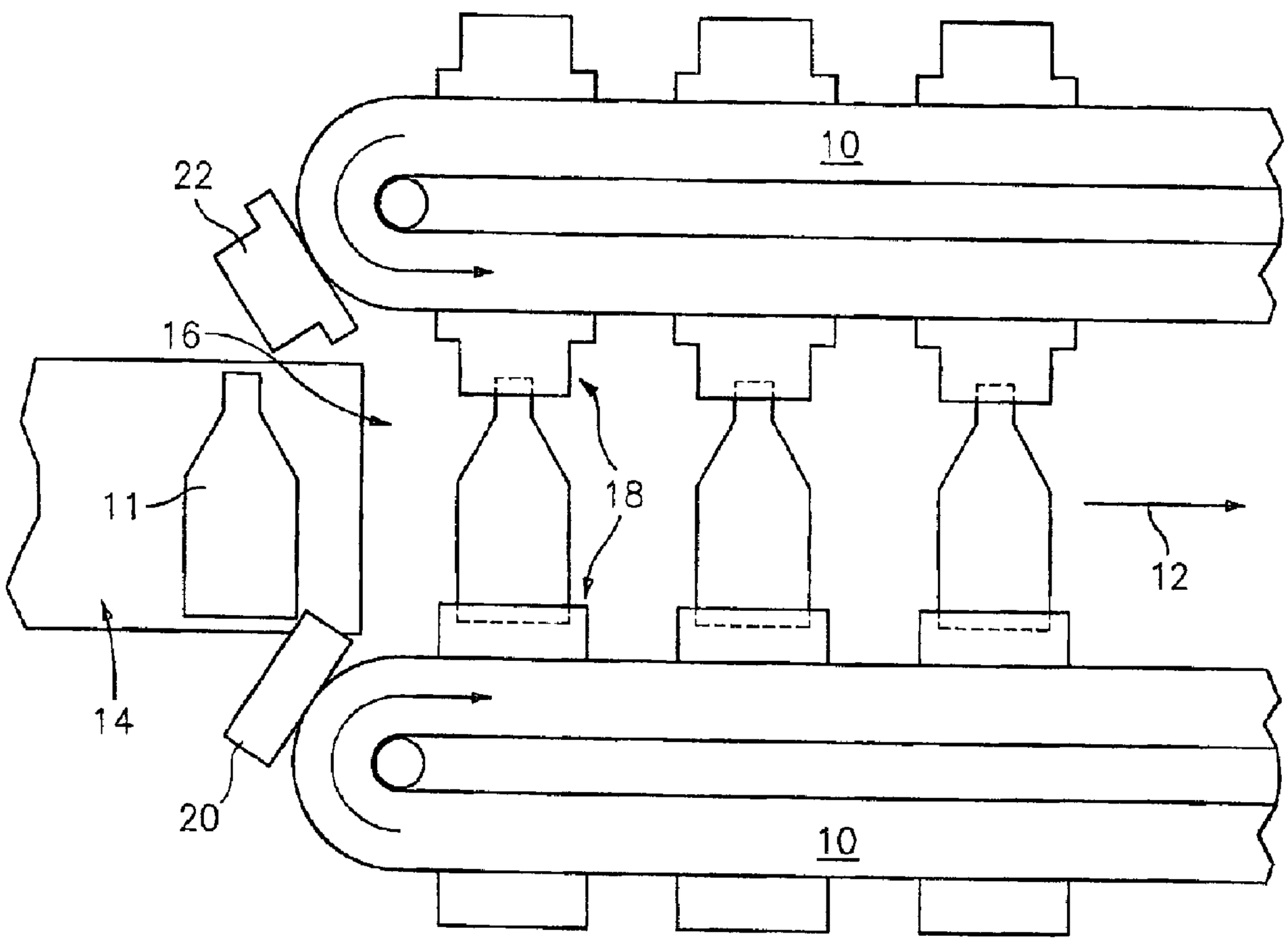
(51) Cl.Int./Int.Cl. *B41F 17/18* (2006.01),
B41F 17/28 (2006.01)

(72) Inventeur/Inventor:
UPTERGROVE, RONALD L., US

(73) Propriétaire/Owner:
PLASTIPAK PACKAGING, INC., US

(74) Agent: OGILVY RENAULT LLP/S.E.N.C.R.L.,S.R.L.

(54) Titre : IMPRESSION D'IMAGES NUMERIQUES SUR DES CONTENANTS EN PLASTIQUE
(54) Title: PRINTING PLASTIC CONTAINERS WITH DIGITAL IMAGES



(57) Abrégé/Abstract:
A method for printing digital images on plastic containers having curved surfaces, including providing a series of hollow plastic containers, moving the containers along a track past first and second digital printing locations, and printing first and second digital

CA 2531035 C 2009/03/10

(11)(21) 2 531 035

(13) C

(57) Abrégé(suite)/Abstract(continued):
images on the curved container surfaces while maintaining the container being printed under internal pressure and while firmly holding the container being printed at spaced locations thereon.

04-212-1

ABSTRACT OF THE DISCLOSURE

A method for printing digital images on plastic containers having curved surfaces, including providing a series of hollow plastic containers, moving the containers along a track past first and second digital printing locations, and printing first and second digital images on the curved container surfaces while maintaining the container being printed under internal pressure and while firmly holding the container being printed at spaced locations thereon.

PRINTING PLASTIC CONTAINERS WITH DIGITAL IMAGES

BACKGROUND OF THE INVENTION

The present invention relates to plastic containers having digital images printed thereon, particularly curved plastic containers.

Conventional techniques for printing onto curved plastic containers are subject to significant drawbacks. For example, it is difficult to obtain proper registration between colors, and changing images, designs or wording is expensive and time consuming.

Inkjet printing with multiple nozzles is useful for flat surfaces. However, it is difficult to satisfactorily use multiple nozzles on curved surfaces.

It would be highly desirable to print a digitally generated image directly onto a plastic container, particularly a curved plastic container, wherein the printing can be done at a reasonable speed and at a reasonable cost.

SUMMARY OF THE INVENTION

The present invention provides for printing digital images or indicia directly onto a plastic container, particularly a curved, plastic container, and accomplishing this in a continuous operation at a reasonable speed and at a reasonable cost. Full color digital graphic images or indicia may be directly printed onto containers at multiple areas thereon.

Thus, in accordance with the present invention, there is provided a method for printing digital images on plastic containers having curved surfaces, which comprises:

providing a series of hollow plastic containers each having a curved external surface;

moving said containers along a track and past a digital printing location;

providing a plurality of independently movable print heads at said printing location, wherein said print heads are separately movable perpendicular to the direction of container flow, and providing a sensor which determines the location of the container

surface to be printed and provides electronic feedback to an articulation device which moves the print heads independent of each other to maintain a constant distance between the container surface to be printed and the print heads; and

printing a digital image on said curved surface of each container by said print heads at said printing location.

In another aspect of the invention, there is provided a plastic container having non-planar surfaces with digital images thereon, which comprises: a hollow plastic container having non-planar external surfaces, said container having a first multiple color, digital image on a first non-planar surface, and a second multiple color digital image on a second non-planar surface, wherein said second non-planar surface is spaced from said first non-planar surface.

In accordance with a particular embodiment of the present invention, a series of plastic containers are firmly held and moved to and from a first digital printing location and a first digital image is printed thereon at the first printing location on a first printing area on the containers, with the containers held at the top thereof and at a second position spaced from the top thereof, preferably at the base. Desirably, the containers are moved from the first digital printing location to a second digital printing location and a second

digital image printed thereon on a second printing area on the containers spaced from the first printing area, with the containers held at the top thereof and at a second area spaced from the top, preferably at the base. The containers are preferably maintained under internal pressure while the digital image or images are printed thereon.

The steps of digitally printing the digital image directly onto the plastic container prints the digital images directly onto a preformed container, for example onto an injection molded or blow molded container, such as polyethylene terephthalate (PET) or high density polyethylene (HDPE). The digital printing operation may print the digital image directly onto the plastic container as by jetting ink through an inkjet print head and onto the container surface. The ink may be a UV-reactive ink, in which case after printing the ink may be cured by exposure to UV light. One may also, for example, treat the container surface to be printed prior to the printing operation, as by flame treatment, corona treatment or plasma jet treatment.

Further features of the present invention will be discussed hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more readily understandable from a consideration of the following illustrative drawings, wherein:

Figure 1 is a top view of the container conveyer with containers;

Figure 2 is a side view of one embodiment of the container flow and treatment;

Figure 3 is a side view of an alternate embodiment of the container flow and treatment;

Figure 4 is a side view of the container clamp assembly; and

Figure 5 is an enlarged side view of an alternate embodiment of the container flow and treatment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As can be seen from Figures 1 – 3, a conveyer assembly 10 is provided to move the containers 11 through the treatment procedure in the direction of flow 12. The containers 11 enter the conveyer assembly from infeed conveyer 14 at container entry 16 and are secured in container clamp assembly 18. The clamp assembly secures the containers 11 at two spaced areas, as shown in Figures 1 and 4, by container base holder 20 and container top holder 22. It is preferred to hold the container at the top and bottom, although one could employ a top holder plus a second holder spaced therefrom, as on the sidewall. This prevents the containers from moving in any direction except for the direction of container flow 12. The base holder 20 and top holder 22 are synchronized to maintain the same velocity and relationship to each other at all times. Naturally, a commercial operation may have more than one conveyer assembly line.

As can be seen, particularly in Figures 2 and 3, the containers 11 are curved, as for example, round or oval, and have a container radius or curved portion 24. The container track 26 also contains a radius of the curved portion 28 at the first printing site

30 which should substantially equal the container radius 24 to be printed in order to facilitate the digital printing operation.

Upon clamping container 11 at the container entry 16 internal pressure is applied to the inside of the container via air pressure means 32 and pressure line 34 (Figure 4) through the clamp assembly 18, as for example, through top holder 22. Preferably, a pressure regulator 36 is provided to regulate the air pressure, as for example, from 0.125 – 10.0 psi. This internal pressure will be maintained throughout the treatment procedure and provides a consistent distance of the container surface from the inkjet head and/or a consistent contact pressure for the container surface to the ink roller if the indirect inkjet method is used.

As the containers enter the track curved portion or radius 28 they first pass through a first pre-treatment location A-1, see Figures 2 and 3. The pre-treatment location will serve to raise the surface energy of the container on the first container surface 38 to insure ink adhesion thereon, as for example, a heat treatment or corona treatment.

The containers will then pass the first printing site 30, area B-1 in Figures 2 and 3. The containers will then have the first printing applied on the first container surface 38 at printing site 30, which may be a direct drop on demand inkjet head as shown in Figure 3, or an indirect drop on demand inkjet pad 40 as shown in Figure 2. U.V. ink will be applied directly to the first surface 38 of the containers in one pass. The inkjet may apply multicolor graphics of high quality as desired.

The printed containers will then pass through a first curing station C-1, which will cure the ink or inks applied at the first printing site 30. This may be an ultra violet light source or other radiant curing method.

The containers 11 then enter a straight section 42 of container track 26 where they are rotated, as for example, 180°, to expose second surface 44 of the containers to the second printing site 46, as by the clamp assembly 18 or other rotating means. The second container surface 44 is spaced from the first container surface 38, desirably an area opposed to the first container surface, as 180° therefrom.

After rotation the containers 11 with container first surface 38 having printing thereon are moved through a second pre-treatment area A-2 where the surface energy of the container on the container second surface 44 is raised as at the first pre-treatment area A-1. The containers will then pass the second printing site 46, area B2, wherein the second printing will be performed on the second surface 44 of the containers.

Similar to first printing site 30, printing at the second printing site may be a direct drop on demand inkjet head as shown in Figure 3 or an indirect drop on demand inkjet pad 40 as shown in Figure 2. Also, at the second printing site 46 U.V. ink will be applied directly to the second surface 44 of the containers in one pass, as multicolor graphics of high quality, as desired.

The printed containers will then pass through a second curing station C-2 which will cure the ink or inks applied at the second printing site. Here again, this may be an ultra violet light source other radiant curing method.

The container clamp assembly 18 will then release the containers, printed on two sides or two locations and pass them on to an out-feed conveyer or storage and return to repeat the cycle.

In the printing procedure it is desirable to maintain a plurality of print heads at a constant distance and perpendicularity from the non-planar container surface during the printing process. A plurality of print heads may be desirably articulated during the printing process to maintain a constant distance and perpendicularity from the non-planar container surface. A plurality of sensors may be used to measure the curvature of the non-planar surface and to control the articulation of the plurality of print heads to maintain the constant distance and perpendicularity from the non-planar surface. The print heads and/or container are desirably moved at a constant velocity relative to the non-planar surface during the printing process. Also real time control is preferably provided to the printing control system to determine the relative position of the non-planar surface to the printing process. The foregoing features provide improved digital printing on the curved container surface.

Thus, for example, as shown in Figure 5 which shows an enlarged view of the first printing site 30, area B-1, the conveyer system or container track 26 can be straight. The containers 11 with their container radius or curved portions 24 pass under print heads 50 which are each separately movable up and down perpendicular to the direction of the container flow 52 in the direction of print head movement 54 by suitable motive means as articulation device 56. A constant distance or spacing between the container surface to be printed and the print heads is therefore maintained by the use of measuring device or

sensor 58, such as a laser sensor, which determines the location of the surface to be printed and provides electronic feedback to the articulation device 56 for appropriately moving the print heads. Thus, as the containers pass under the print heads each head may move up and down as desired independent of each other and coordinated to the desired printing location. Subsequent processing will proceed in a manner after that shown in Figures 2 and 3 with a straight container track, desirably rotating the container, and printing at the second printing side.

Thus, the present invention provides an improved procedure for printing digital images or indicia directly onto a curved plastic container. The procedure is continuous and efficient and enables two sides or two areas to be efficiently printed.

It is to be understood that the invention is not limited to the illustrations described and shown herein, which are deemed to be merely illustrative of the best modes of carrying out the invention, and which are susceptible of modification of form, size, arrangement of parts and details of operation. The invention rather is intended to encompass all such modifications which are within its spirit and scope as defined by the claims.

CLAIMS:

1. A method for printing digital images on plastic containers having curved surfaces, which comprises:

providing a series of hollow plastic containers each having a curved external surface;

moving said containers along a track and past a digital printing location;

providing a plurality of independently movable print heads at said printing location, wherein said print heads are separately movable perpendicular to the direction of container flow, and providing a sensor which determines the location of the container surface to be printed and provides electronic feedback to an articulation device which moves the print heads independent of each other to maintain a constant distance between the container surface to be printed and the print heads; and

printing a digital image on said curved surface of each container by said print heads at said printing location.

2. A method according to claim 1, wherein said sensor determines the location of individual container surfaces to be printed.

3. A method according to claim 1 or 2, wherein said moving step moves the containers along a track past a first printing location to print a first digital image on a curved surface of each container, and including moving the containers along said track past a second printing location and printing a second digital image on a curved surface of each container.

4. A method according to claim 3, wherein said second printing location includes a plurality of independently movable print heads which are separately movable perpendicular to the direction of container flow, and a sensor which determines the location of the curved surface of each container for printing said second digital image.

5. A method according to claim 4, wherein the first digital image is printed on a first printing area of said containers, and the second digital image is printed on a second printing area of said containers.

6. A method according to any one of claims 3 to 5, wherein said first and second printing locations are spaced from each other.

7. A method according to any one of claims 3 to 6, wherein said track includes at least one curved portion, wherein at least the first printing location is adjacent the track curved portion.

8. A method according to claim 7, wherein said track includes two curved portions, with the first and second printing location being adjacent a separate track curved portion.

9. A method according to claim 7, wherein the radius of the track curved portion substantially equals the container radius to be printed.

10. A method according to any one of claims 3 to 9, including providing internal pressure to the container during the printing steps.

11. A method according to claim 10, including holding said containers during printing by a clamp assembly, and applying pressure to the container through the clamp assembly.

12. A method according to claim 11, including regulating air pressure within the containers during printing to from 0.125 to 10.0 psi.

13. A method according to any one of claims 3 to 12, wherein said containers are rotated after the first printing step and before the second printing step to expose a non-printed curved surface at said second printing location.

14. A method according to any one of claims 3 to 13, wherein the first and second digital images are printed on opposed sides of each container.

15. A method according to any one of claims 3 to 14, including a curing step after each printing step.

16. A method according to 15, wherein said curing step is a radiant curing method.

17. A method according to any one of claims 3 to 16, including a pretreatment step before each printing step.

18. A method according to claim 1 or 2, wherein said sensor is a laser sensor.

19. A method according to claim 1 or 2, including the step of maintaining the container being printed under internal pressure and while holding said container being printed at spaced locations thereon.

20. A method according to claim 19, wherein the containers are held at the top and base thereof.

21. A method according to claim 1 or 2, wherein said containers pass through a pre-treatment step prior to printing.

22. A method according to claim 21, wherein said pre-treatment is one of a heat treatment and corona treatment to raise the surface energy of the container to insure ink adhesion thereon.

23. A method according to claim 1 or 2, wherein said containers pass through a curing step after printing.

24. A method according to claim 1, wherein said track is a straight track.

25. A method according to any one of claims 1 to 17, wherein said print head movement includes up and down movement.

26. A method according to any one of claims 1 to 17, wherein print heads are direct drop on demand inkjet head.

27. A method according to any one of claims 1 to 17, wherein said print heads apply UV ink directly to the container surface in one pass.

28. A method according to any one of claims 1 to 17, wherein said print heads are moved at a constant velocity relative to the container surface.

29. A method according to any one of claims 1 to 17, wherein the movement of said print heads are coordinated to the printing location.

30. A method according to any one of claims 1 to 17, wherein said printing is directly onto said container and wherein said method is continuous.

31. A method according to any one of claims 1 to 17, wherein said containers are moved at a constant velocity along said track.

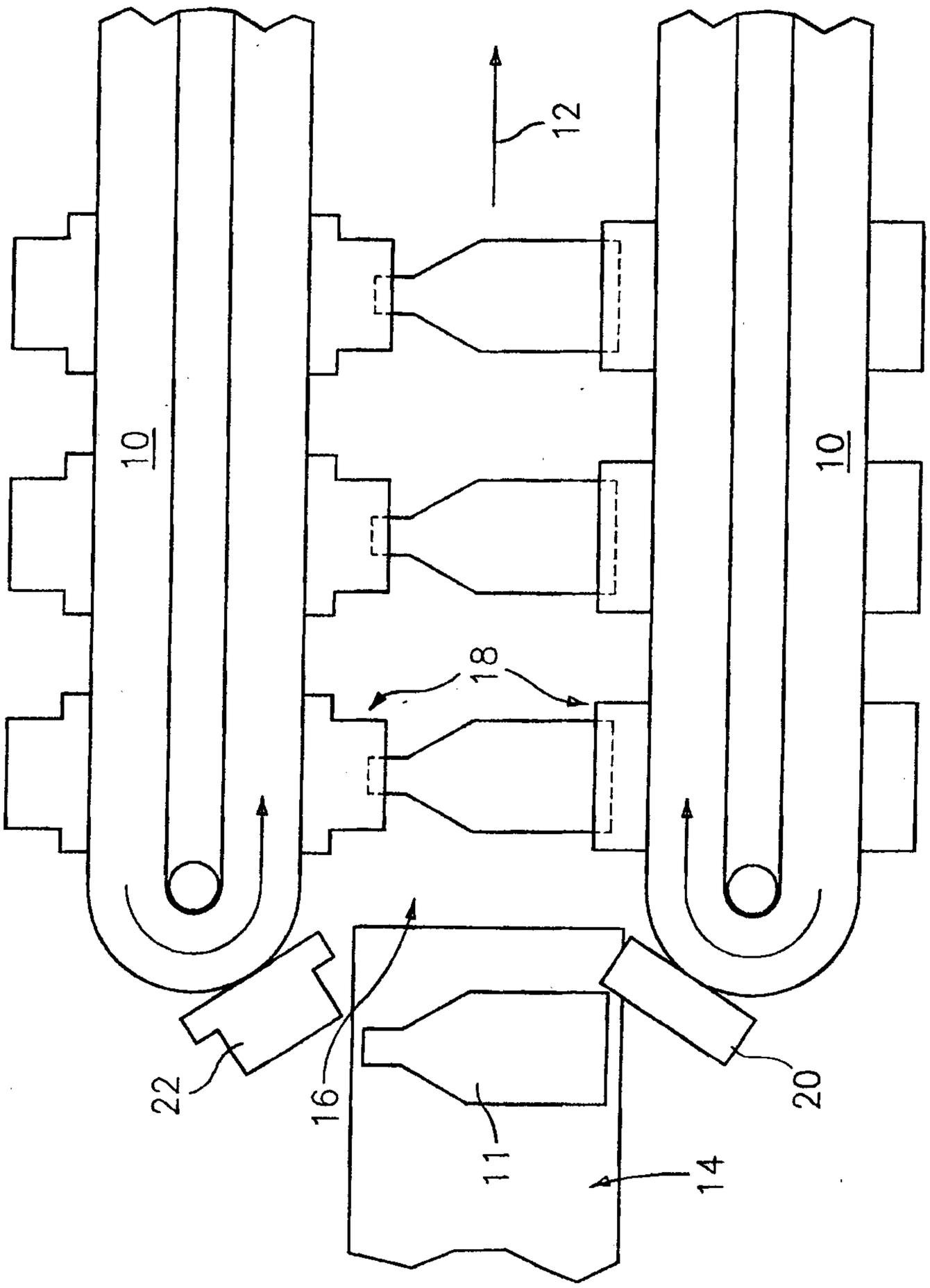


FIG. 1

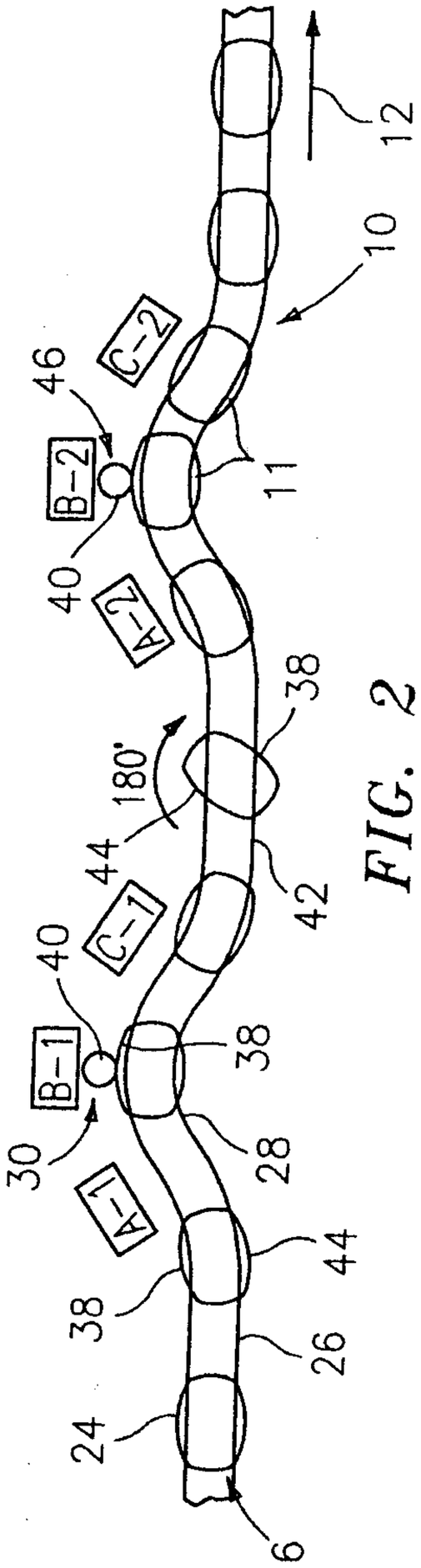


FIG. 2

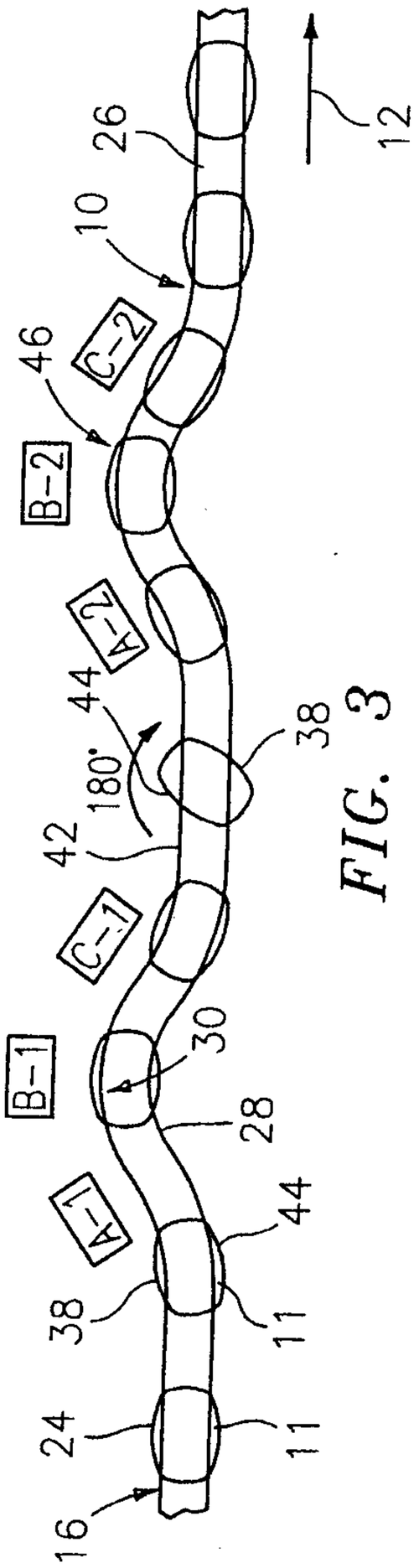


FIG. 3

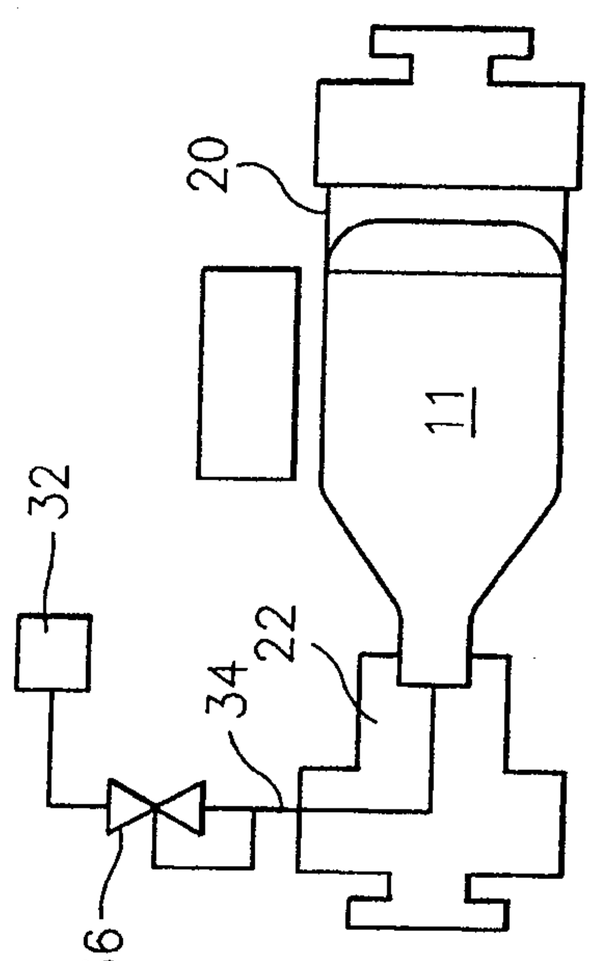


FIG. 4

B-1

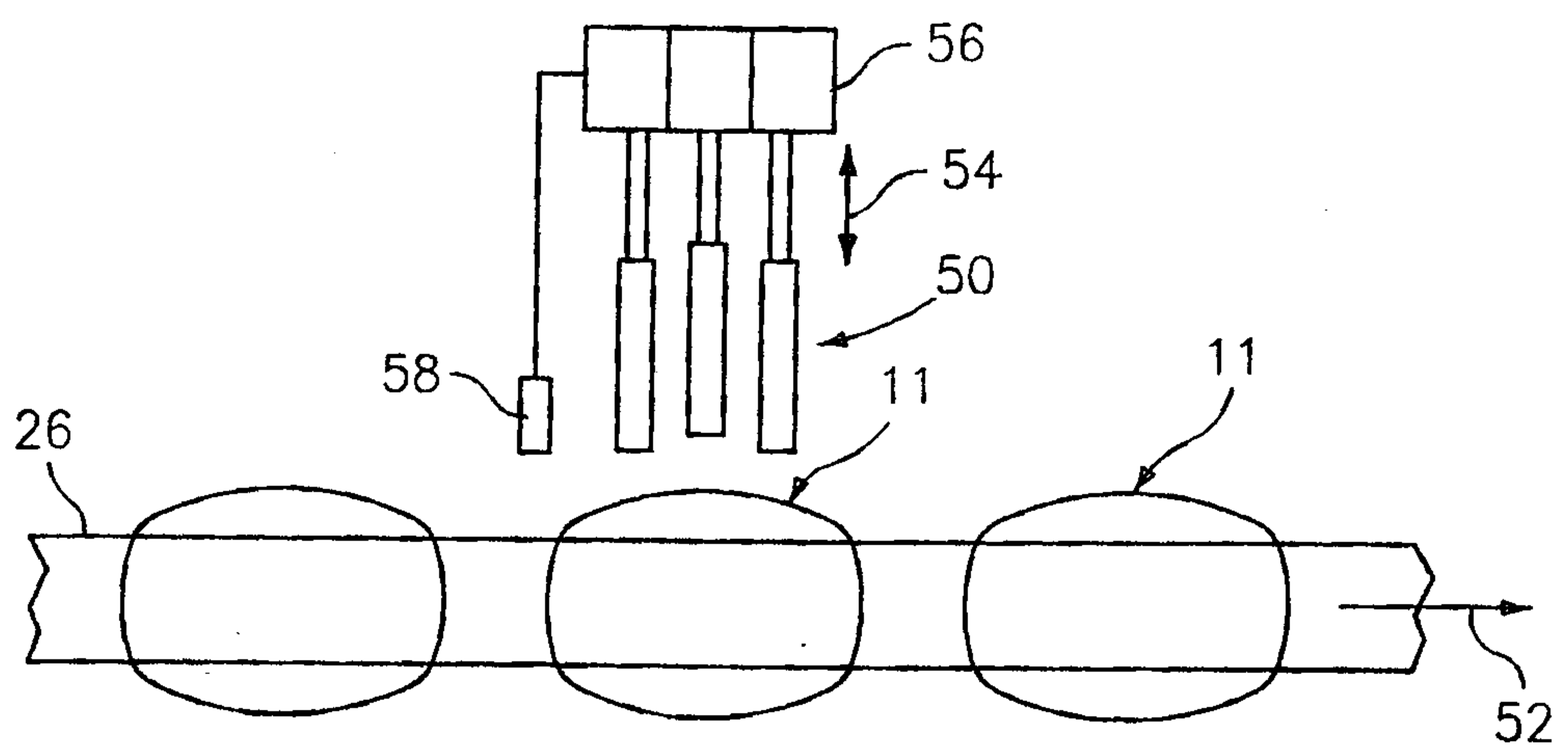
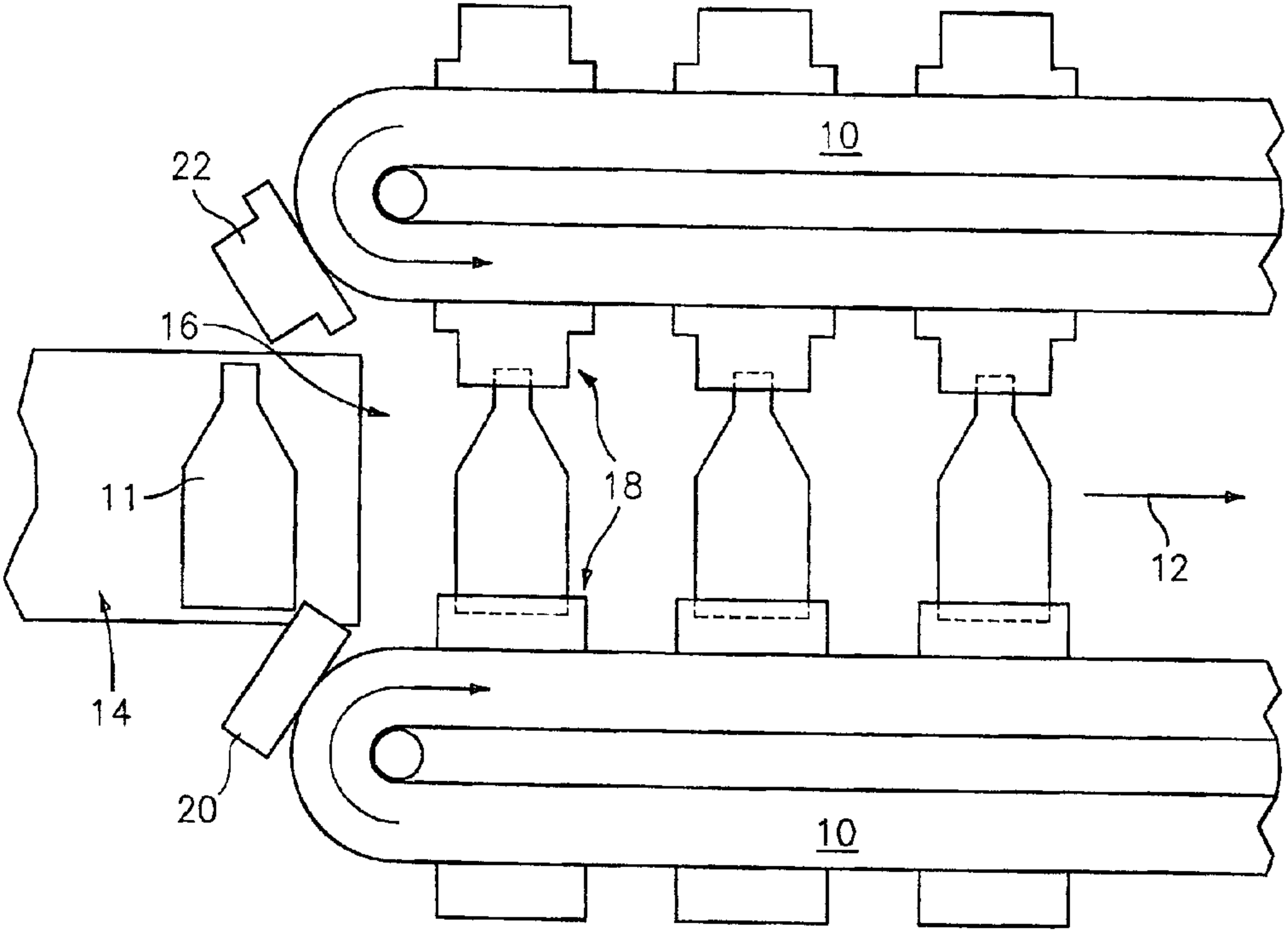


FIG. 5


10
22
16
11
18
12
14
20
10