US 20140109513A1

(19) **United States**

(12) **Patent Application Publication**

Van Rens et al.

(10) **Pub. No.: US 2014/0109513 A1**

(43) **Pub. Date: Apr. 24, 2014**

(54) **SEALING SYSTEM FOR A PACKAGING MACHINE**

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(21) Appl. No.: **14/116,388**

(22) PCT Filed: **May 2, 2012**

(86) PCT No.: **PCT/EP2012/001877**

§ 371 (c)(1),
(2), (4) Date: **Dec. 10, 2013**

(30) **Foreign Application Priority Data**

May 10, 2011 (EP) 11003838.7
May 11, 2011 (EP) 11003879.1

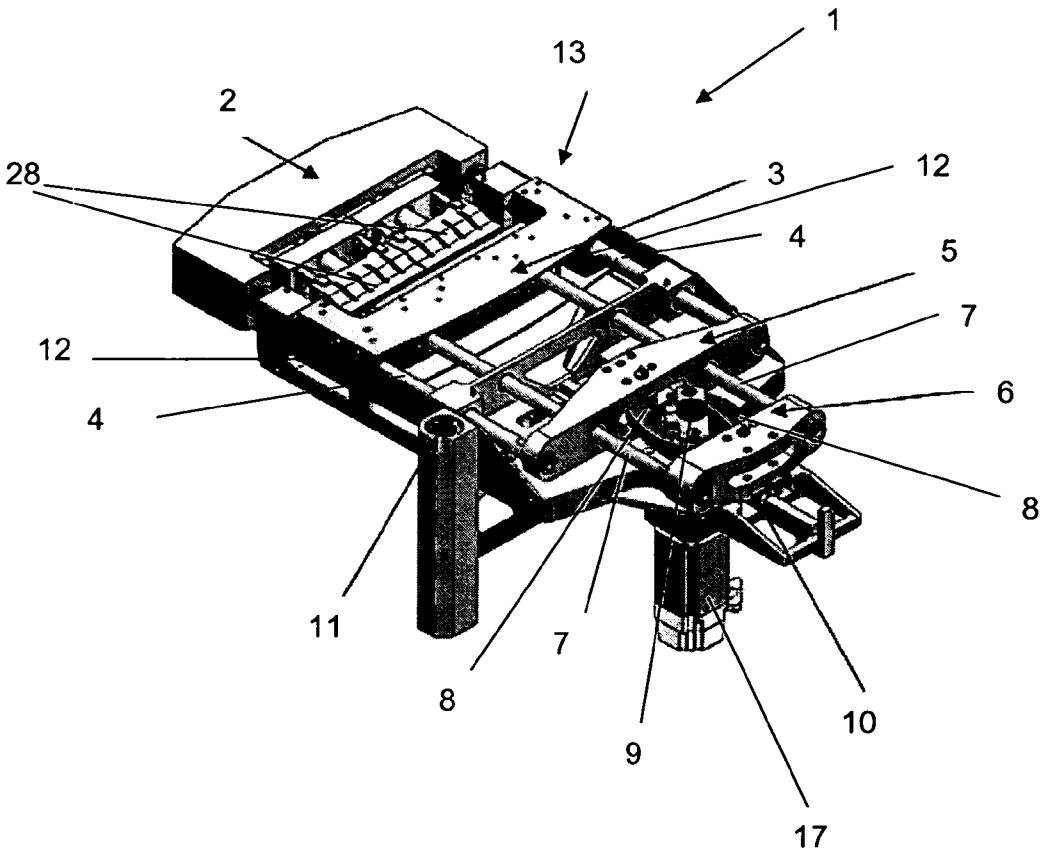
Publication Classification

(51) **Int. Cl.**
B65B 51/10 (2006.01)

(52) **U.S. Cl.**
CPC ***B65B 51/10*** (2013.01)
USPC **53/285**

(57) **ABSTRACT**

The following invention relates to a packaging machine with a sealing system comprising a front jaw and a rear jaw which reciprocate between an open-and a sealing-position, respectively, whereas a front jaw comprises two guide shafts which are supported in a frame.



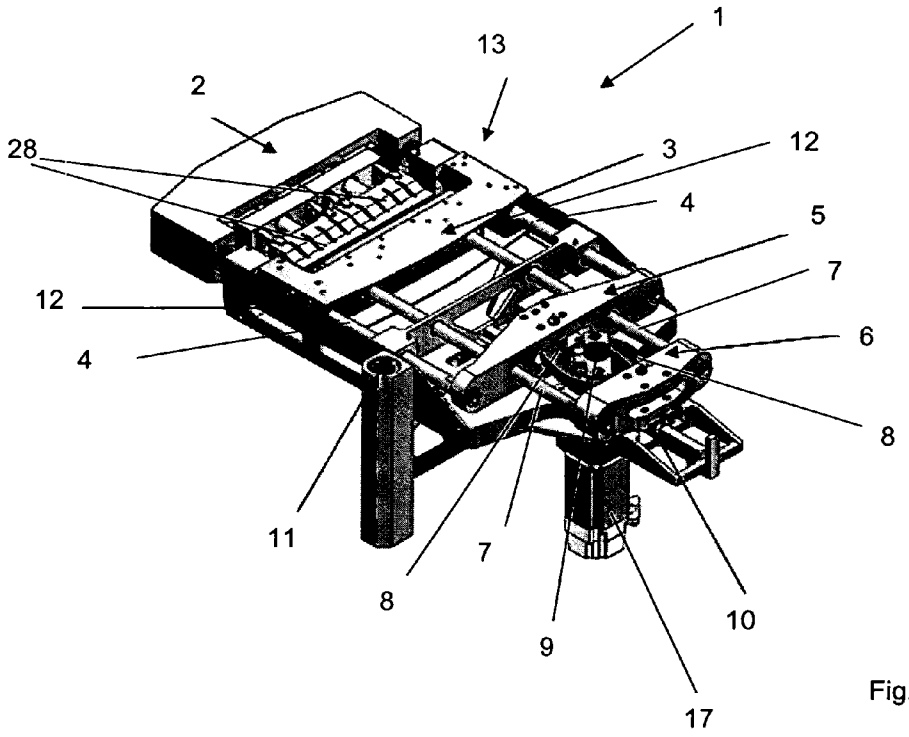


Fig. 1

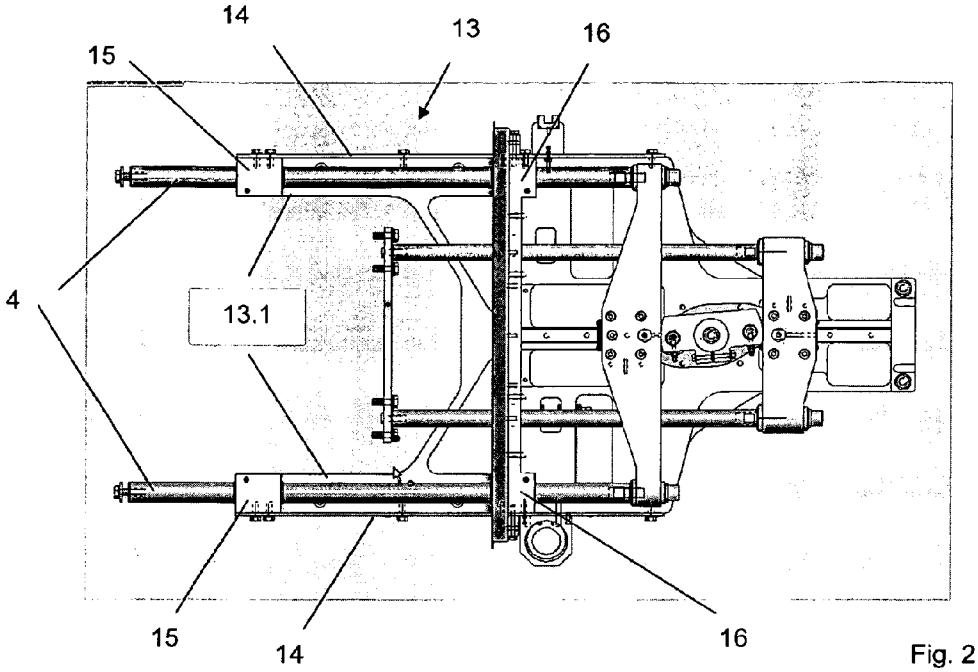


Fig. 2

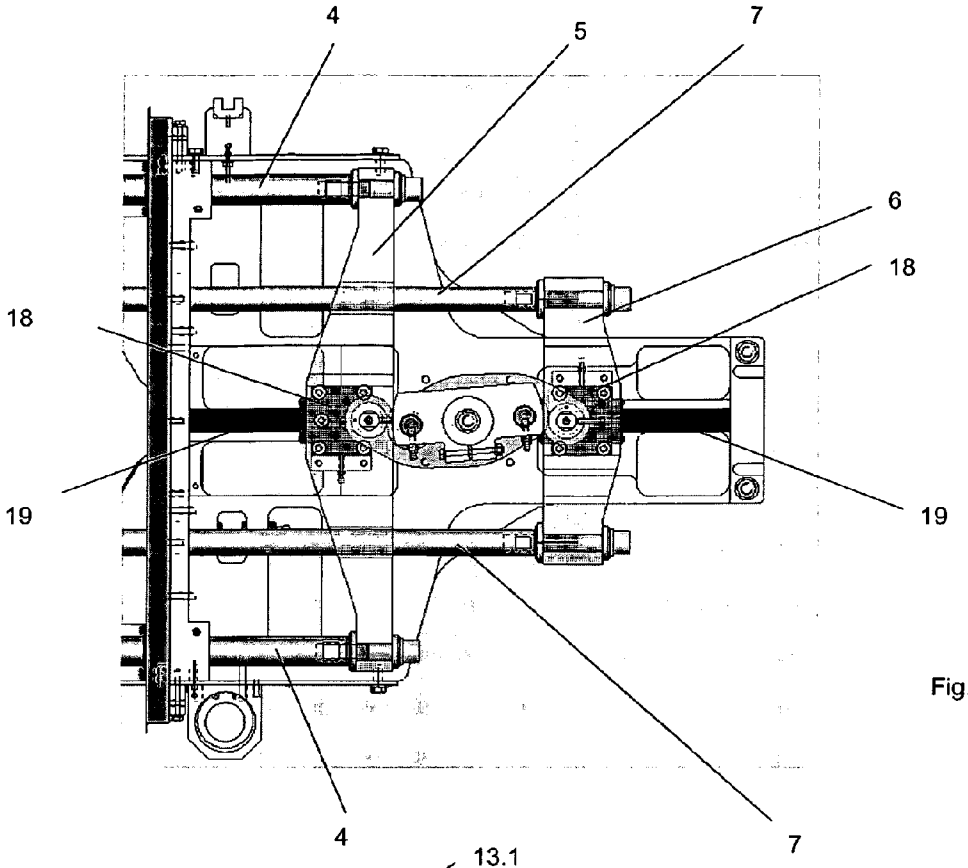


Fig. 3

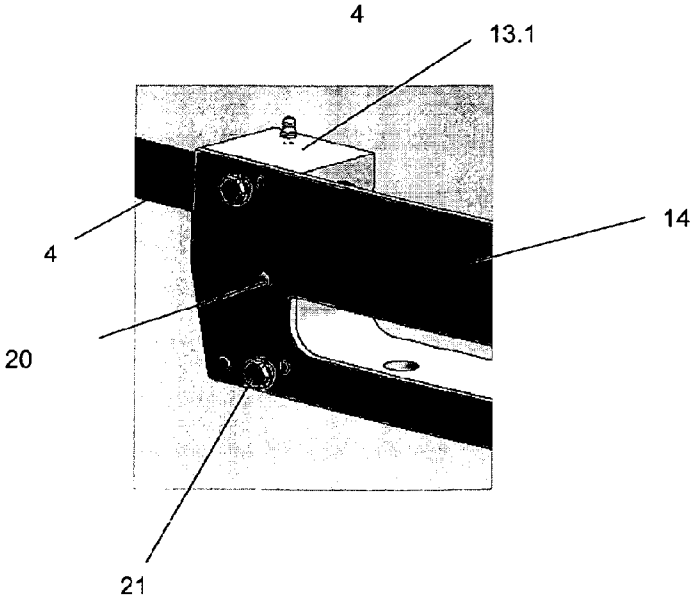


Fig. 4

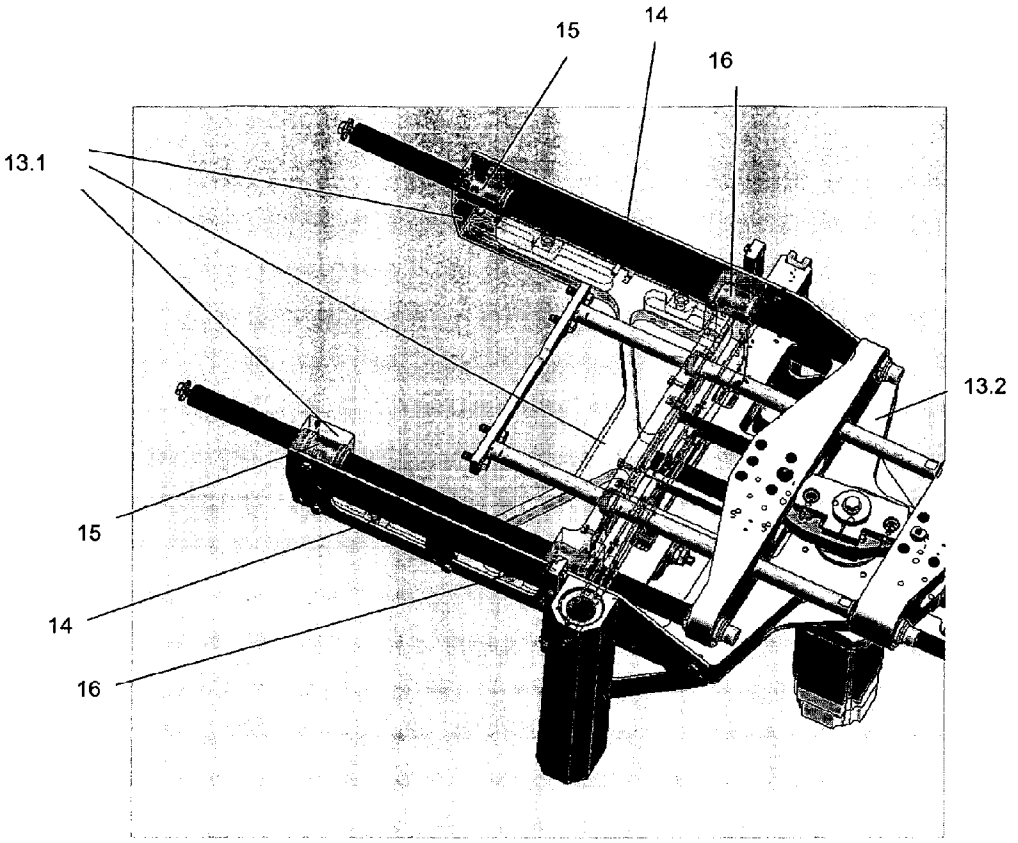


Fig. 5

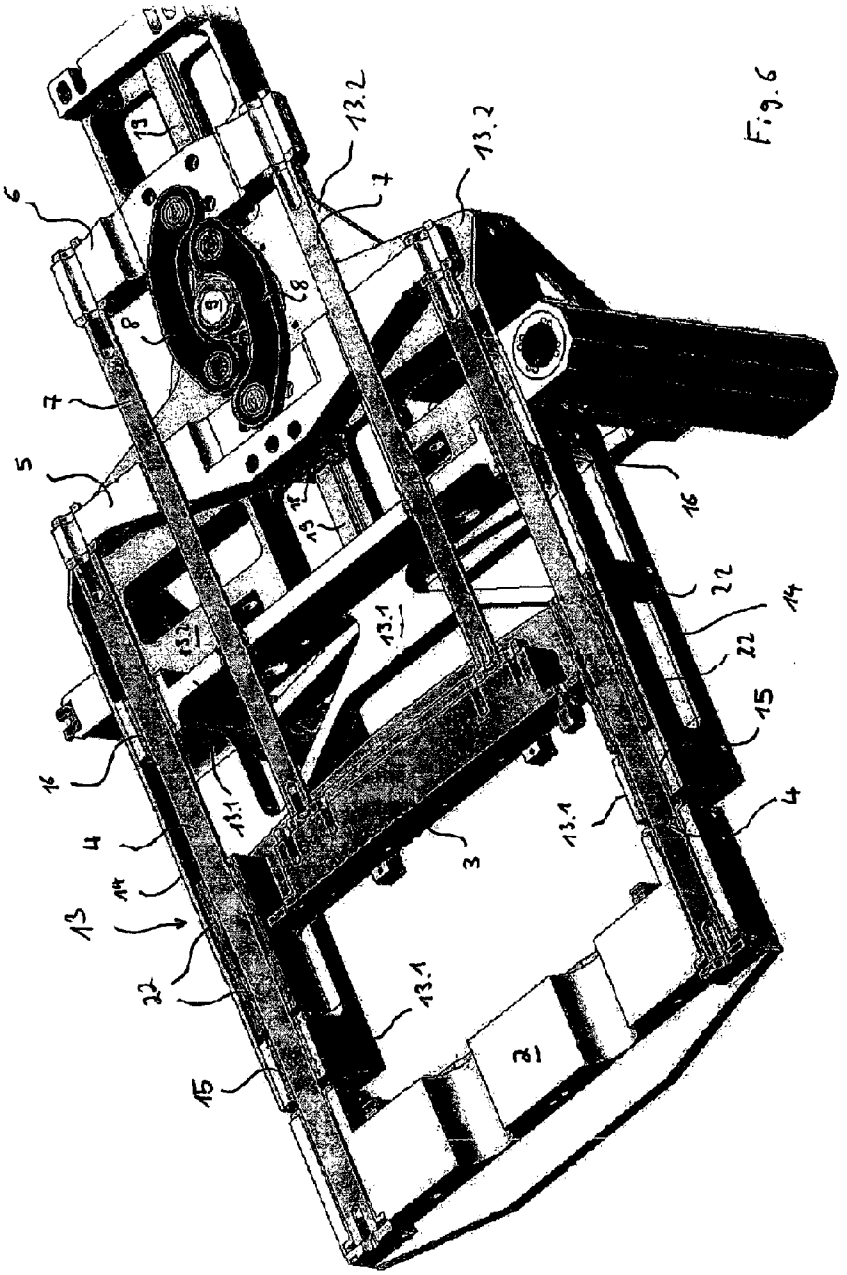


Fig. 6

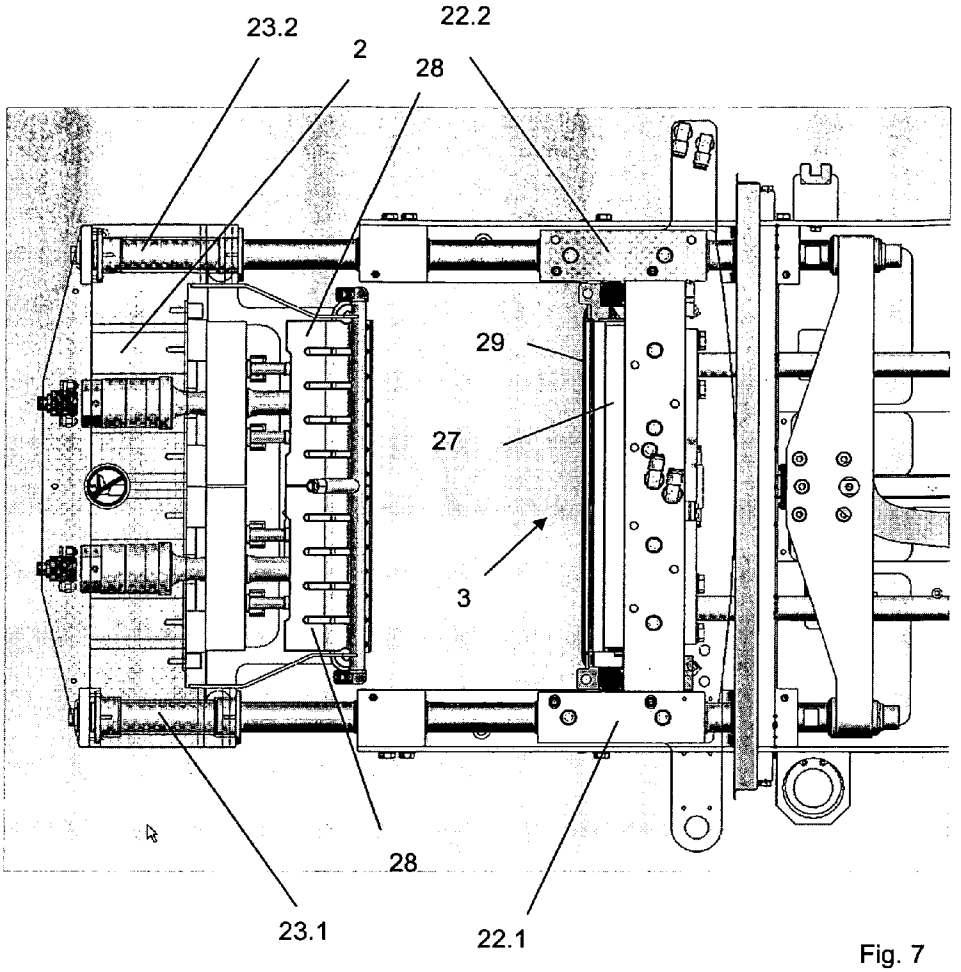


Fig. 7

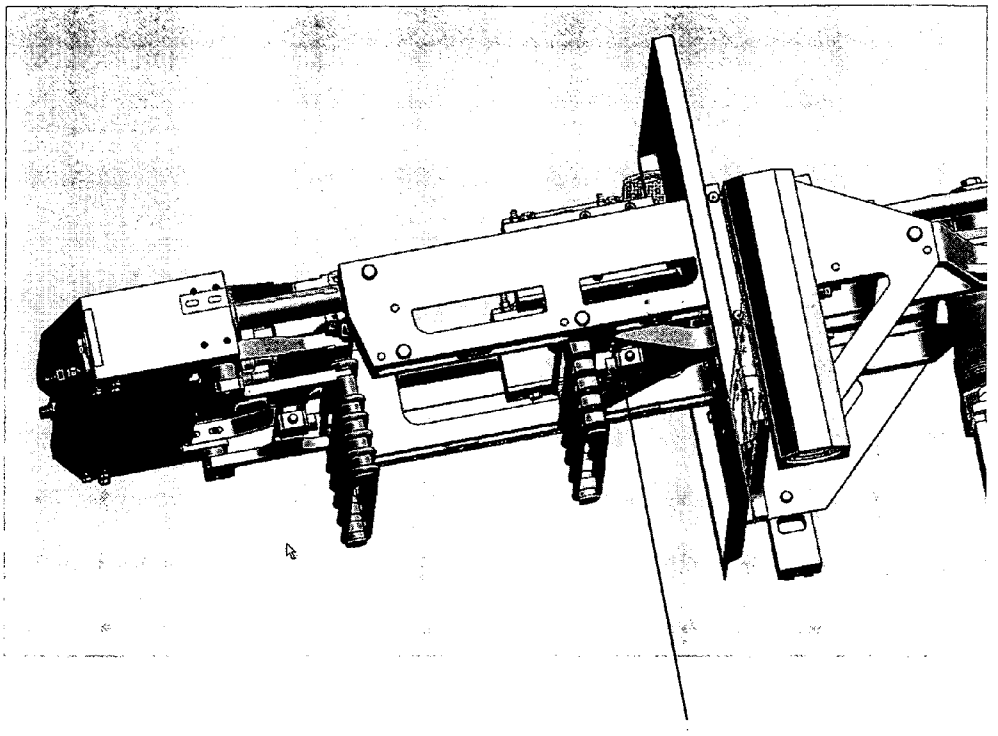


Fig. 8

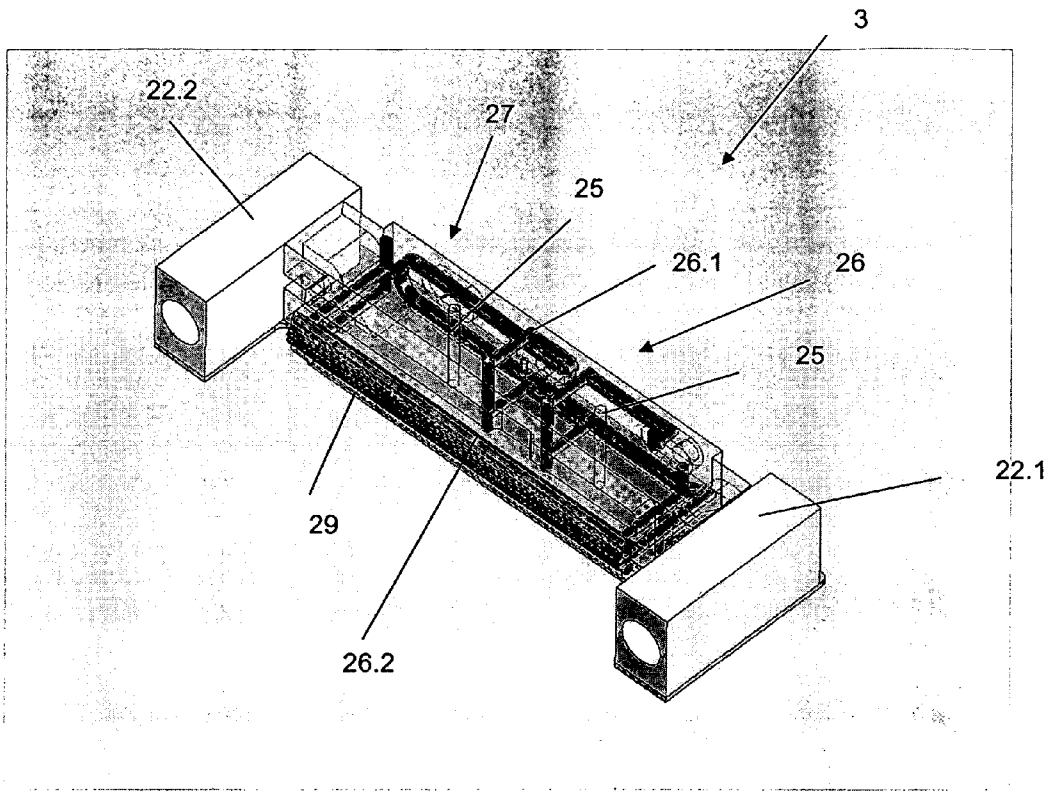


Fig. 9

SEALING SYSTEM FOR A PACKAGING MACHINE

[0001] The present invention relates to a packaging machine with a sealing system comprising a front jaw and a rear jaw which reciprocate between an open- and a sealing-position, respectively, whereas the front jaw comprises two guide shafts which are supported in a frame.

[0002] Such a packaging machine is known from the state of the art and is for example a so called vertical flow wrapper in which a film is formed into a tube and is provided with a longitudinal seal. This tube is filled with the packaging item and a cross seal is provided at the lower and the upper end of the package. Subsequently, the package is separated from the film tube. The cross seal is applied by a sealing system which comprises a front jaw and a rear jaw which reciprocate between an open and a sealing position. The sealing system of these packaging machine is, however, rather complicated.

[0003] It was therefore the objective of the present invention to provide a packaging machine which does not comprise the deficiencies according to the state of the art.

[0004] The problem is attained with a packaging machine with a sealing system, comprising a front jaw and a rear jaw, which reciprocates between an open- and a sealing-position, respectively, whereas the front jaw comprises two guide shafts which are supported in a frame and whereas the rear jaw is supported on the guide shafts of the front jaw.

[0005] The disclosure made regarding this embodiment of the present invention also applies to the other embodiments and vice versa.

[0006] The present invention relates to a packaging machine, which packages a packaging item into individual packages. Preferably this packaging machine is a so called vertical flow wrapper, which forms a plain film into a tube, provides a longitudinal seal to the film tube, fills the film tube with a packaging item and provides a cross seal at the top and at the bottom of each package in order to close the package hermetically. Subsequently or simultaneously, the package is separated from the film tube. In order to apply the cross seal to the package, the inventive packaging machine comprises a sealing system. This sealing system has a front jaw and a rear jaw, which reciprocate between an open- and a sealing position. In the sealing position, the two jaws interact and apply heat and/or pressure to the film tube in order to apply the cross-seal. In the open position, the two jaws are removed from the film tube. The front jaw comprises two guide shafts, which are supported in a frame of the sealing system and which guide the linear movement of the front jaw from its open to its sealing position and vice versa. According to the present invention, the guide shafts of the front jaw are also utilize to support/guide the rear jaw during its linear movement from the open- to the sealing-position and vice versa. This assures, that there is no offset between the front and the rear jaw and that the system is very stiff.

[0007] According to another or a preferred embodiment of the present invention, each guide shaft of the front jaw comprises two bearings, respectively. According to this embodiment of the present invention, all these four bearings are situated in a frame which is made from a single piece. This reduces manufacturing tolerances, simplifies the construction and provides optimal stiffness.

[0008] The disclosure made regarding this embodiment of the present invention also applies to the other embodiments and vice versa.

[0009] According to a preferred embodiment of the present invention, one bearing of each guide shaft of the front jaw is located between the front jaw and the rear jaw. This preferred embodiment of the present invention gives the sealing system maximum stability in the sealing position, since, during sealing, the frame, the front jaw and the rear jaw are very close together.

[0010] According to another or a preferred embodiment of the present invention, the front jaw and the rear jaw are connected to a beam, respectively. Both these beams are, according to this embodiment of the present invention, supported at the frame by linear guiding means. This avoids, that the guide shaft of the front jaw are subjected to shear forces.

[0011] According to another or a preferred embodiment of the present invention, the motor drives the jaws and provides the pressure needed for the sealing with ultrasonic sound. There are no other means needed to position the jaws and/or to provide the necessary pressure during the ultrasonic sealing.

[0012] According to a preferred embodiment of the present invention, the bearings of the inventive packaging machine are free from play. Preferably, the play between the bearing and the bared part is less than 20, preferably 10 micrometers.

[0013] Preferably, the jaws are driven by a servo motor.

[0014] According to another preferred embodiment of the present invention, the frame of the sealing system is made from two segments, which are connected by two side plates.

[0015] Preferably, the connection between the two segments and/or the connection between the side plates and the segments comprises dowel pins, in order to reduce manufacturing tolerances.

[0016] Preferably, at least one sealing jaw comprises a sonotrode for sealing of the film material with ultrasonic sound.

[0017] According to a preferred embodiment of the present invention, each jaw comprises two connections with shaft, respectively, whereas one connection of each jaw is preferably an adjustable connection and one connection of each jaw is preferably a fixed connection. This adjustment allows the exact positioning of the jaws relative to each other, particularly the parallel positioning of the jaws in one or two planes. Additionally or exclusively, the jaws can be adjusted relative to the shaft at a certain temperature, respectively. Preferably, the connection between the front jaw and the shaft comprises an adjustable bush in a chamber in the front jaw. Preferably the connection between the rear jaw and the shaft is an adjustable block. The jaws will be assembled and adjusted at a certain temperature.

[0018] Preferably, the sealing system comprises a heating- and/or cooling-means and more preferably a temperature sensor. The sealing system can preferably only be started and/or operated in case the temperature of the sealing system, particularly the temperature of one or both jaw(s) is/are in a range of the temperature at which it has been adjusted. If the temperature is out of this range, one or both jaws will either be cooled or heated. Preferably the rear jaw comprises an anvil which is heated to adjust the temperature.

[0019] Preferably, the sealing system comprises a film sensor. The sealing system can only be operated when the film sensor detects the presence of a film.

[0020] Another subject matter of the present invention is a sealing-jaw of a packaging machine that comprises heating- and/or cooling means.

[0021] The disclosure made regarding this embodiment of the present invention also applies to the other embodiments and vice versa.

[0022] The heating and/or cooling means are utilized to heat or cool the sealing jaw to a certain temperature and/or to maintain the sealing jaw at a certain temperature. Preferably, the heating means is an electrical heating means, for example one or more heating cartridge(s). Preferably, the heating- and/or the cooling means are designed such that anvil of the jaw and the bearings of the sealing jaw comprises an at least essentially uniform temperature, respectively. This assures that there is no or only minimal distortion in the anvil, the bearings and/or the jaw, so that so that the front jaw and the rear jaw are perfectly parallel, which is particularly essential for the sealing of a thin film. The cooling means is preferably a tube system, preferably a tube circuit, in which a liquid, preferably water flows and is preferably circulated and which, more preferably is provided within the anvil of the sealing jaw. The water flow can be also utilized for heating-purposes. Preferably, the tube system extends along the front- and along the rear side of the anvil. This also assures an, at least essentially, equal temperature of the anvil and thus no distortion. Preferably, a temperature sensor is provided at the anvil, in the vicinity of the anvil and/or in the liquid to measure the temperature of the anvil. Preferably, the temperature of the liquid that is passed through the anvil is 45-50° C., more preferably 48-52° C.

[0023] The heating means are preferably utilized to bring and/or maintain the rear jaw at a certain, more preferably a minimum, temperature.

[0024] Another subject matter of the present invention is a method to seal a packaging with two jaws, whereas at least one jaw, preferably the rear jaw, is tempered prior to sealing.

[0025] The disclosure made regarding this embodiment of the present invention also applies to the other embodiments and vice versa.

[0026] This embodiment of the present invention assures that the quality of the sealing of the film is acceptable even during the entire production period, even after start-up at the beginning of a shift. The temperature of the jaw, particularly the rear jaw and preferably, at least the anvil is heated until a certain temperature is reached. Only then, the inventive packaging machine starts its production. The heating is preferably executed by one or more electrical heating means, preferably heating cartridge(s).

[0027] Yet another subject matter of the present invention is a method to seal a packaging with a sonotrode, whereas the sealing period is adjusted based on the temperature of the sonotrode. According to the present invention, a package, made from a plastic film is formed, filled with a packaging item and then hermetically closed by sealing the film. The sonotrode is untilized to seal a film with ultrasonic sound. The sonotrode provides the ultrasonic sound.

[0028] The disclosure made regarding this embodiment of the present invention also applies to the other embodiments and vice versa.

[0029] According to the present invention, the sealing time is adjusted based on the temperature of the sonotrode. Preferably, the sealing time is decreased with increasing temperature of the sonotrode. The sealing time is the time during which the two sealing jaws are pressed together.

[0030] Preferably, the inventive packaging machine and/or the inventive method is self adapting. For example, after a certain time period after the start of the packaging machine and/or after a certain amount seals have been applied to the film, a control system automatically reduces the sealing time. Alternatively, the temperature of the sonotrode is determined and based on this reading, the sealing time is automatically adjusted.

[0031] The inventions are now explained according to FIGS. **1-9**. These explanations do not limit the scope of protection. The explanation applies to all inventions, respectively.

[0032] FIG. **1** shows the sealing system.

[0033] FIG. **2** shows the bearing of the guide shaft.

[0034] FIG. **3** shows the linear guiding means.

[0035] FIG. **4** shows the connection between the frame and the side plates.

[0036] FIG. **5** shows the bearings in the frame.

[0037] FIG. **6** shows the sealing system.

[0038] FIG. **7** shows the connection between the jaws **2**, **3** and the guide shaft.

[0039] FIG. **8** shows a film sensor.

[0040] FIG. **9** shows the inventive sealing jaw

[0041] FIGS. **1** and **6** show the sealing system **1** of the inventive packaging machine. This sealing system **1** comprises a front jaw **2** and a rear jaw **3** which reciprocate between an open- and a sealing-position. The sealing position is depicted in FIG. **1** and the open position is depicted in FIG. **6**. The front jaw **2** is connected to two guide shafts **4**, which are supported in a frame **13** of the sealing system **1**. At their rear end, the guide shafts **4** are connected to a beam **5**. As can be particularly seen from FIG. **6**, the rear jaw **3** comprises bearings **22**, which support the rear jaw **3** at the guide shafts **4** of the front jaw **2**. Each bearing **22** comprises preferably two segments, which are separated from each other so that a moment of a torque can be easily transferred from the rear jaw **3** to the guide shaft **4**. Additionally, the rear jaw **3** is connected to two drive shafts **7**, which comprise at their rear end a beam **6**. Each beam **5**, **6** is connected with one end of a crank **8**, respectively. The other end of the cranks **8** are connected to a rotational drive **9**, which is driven by a motor **17**, preferably a servo motor. By turning the rotational drive clockwise, the front jaw **2** and the rear jaw **3** move from their open position to the sealing position. A counter clockwise rotation of the rotation drive **9** results in a movement of the jaws **2**, **3** into their open position. In order to avoid, that the guide shaft **4** and/or the drive shaft **7** is subjected to a shear force, both beams **5**, **6** comprise a bearing **18**, respectively, each supported on a linear guiding means **19**. As can be also seen from FIG. **6**, two bearings **15** of the guide shaft **4** are located between the front shaft **2** and the rear shaft **3**. This assures, that the bearing and the front and the rear jaw **2**, **3** are in close proximity during sealing. As can be also seen from FIG. **6**, each guide shaft **4** is supported by two bearings **15**, **16**, respectively, which are relatively far apart in order to increase the stiffness of the system. All four bearings **15**, **16** are situated in a first segment **13.1** of frame **13**, which is machined from a single piece of metal. The entire frame **13** is, in the present case, made from two segments **13.1**, **13.2**, which are connected to each other by two side plates **14**. One segment, **13.1** comprises all four bearings **15**, **16**, the other segment **13.2** comprises the beam **5**, **6** for the jaws **2**, **3**. In order to reduce manufacturing tolerances, the segment **13.1**, **13.2** and all the side plates are connected to each other by dowel pins **20** which can be particularly seen from FIG. **4**. All bearings **15**, **16**, **22** are preferably play free bearings, for example ball recirculating sleeve bearings. In the present case, the sealing

of the film, particularly the cross-seal is provided by means of a ultrasonic sound. Therefore, the sealing system comprises a sonotrode **28**, in the present case two sonotrodes **28**, which are operated in parallel and which are both connected to the front jaw **2**. Preferably, the position of both sonotrodes **28** relative to the front jaw **2** can be adjusted individually. Preferably, the frequency and/or the amplitude of each sonotrode can be set individually.

[0042] Reference is now made to FIG. **2**. It can be clearly seen, that each shaft **4** is supported to the frame **13** by bearings **15**, **16**, which are separated from each other. All four bearings **15**, **16** are supported in one segment **13.1** of frame **13**, which is manufactured from a single piece of metal.

[0043] In FIG. **3**, the linear guiding means **19** of the beams **5**, **6** can be seen, each beam **5**, **6** comprises a bearing **18**, in the present case a play free bearing, which is supported on the linear guiding means **19**. The cooperation of bearings **18** and the linear guiding means **19** avoid, that shear forces are introduced into shafts **4** or shafts **7**. Preferably, the bearing is a ball recirculating sleeve bearing.

[0044] FIG. **4** shows the connection between the segment **13.1** and side plates **14**. The connection comprises dowel pins **10** and fastening means here screws **21**. The dowel pins assure the exact positioning between the segment **13.1** and the side plate **14**.

[0045] From FIG. **5**, it can be seen, that all four bearings **15**, **16** are situated in one segment **13.1** of frame **13**.

[0046] According to FIG. **7**, each jaw **2**, **3** comprises two connections **22.1**, **22.2**, **23.1**, **23.2** with the shafts **4**, respectively, whereas one connection **22.1**, **23.1** of each jaw **2**, **3** is an adjustable connection and one connection **22.2**, **23.2** of each jaw **2**, **3** is preferably a fixed connection. This adjustment preferably allows the exact positioning of the jaws **2**, **3** relative to each other, particularly the parallel positioning of the jaws **2**, **3** relative to each other in one or more plane(s). Additionally or exclusively, the jaws **2**, **3** can be adjusted relative to the shaft **4** at a certain temperature, respectively. Preferably, the connection between the front jaw and the shaft comprises an adjustable bush in a chamber in the front jaw. Preferably the connection between the rear jaw and the shaft is an adjustable block. The jaws will be assembled and adjusted at a certain temperature. Preferably, the sealing system comprises a heating- and/or cooling-means and more preferably a temperature sensor. The sealing system can preferably only be started and/or operated in case the temperature of the sealing system, particularly the temperature of one or both jaw(s) is in a range of the temperature at which it has been adjusted. If the temperature is out of this range, one or both jaws will either be cooled or heated or the system will be shut down. Preferably the rear jaw comprises an anvil which is heated to adjust the temperature.

[0047] In FIG. **8**, the sealing system comprises a film sensor **24**. The sealing system can only be operated when the film sensor **24** detects the presence of a film.

[0048] FIG. **9** shows the inventive rear sealing jaw **3**, which comprises, in the present case, an anvil **27** and two bearings **22.1**, **22.2**, in the present case designed as bearing-blocks. In the present example, the sealing of the film is applied by ultrasonic sound, which is provided by a sonotrode, which Is part of the front jaw **2**. At its front side, the anvil comprises a sealing bar **29**, which is in contact with the film, in order to apply the seal to the film, which, during sealing, is pressed between the sonotrode **28** and the sealing bar **29**.

[0049] According to the present invention, the rear jaw **3**, particularly its anvil **26** is heated and/or cooled, to bring and/or maintain the sealing jaw and/or the anvil at a certain temperature, whereas a uniform temperature, particularly over the entire anvil **26**. A uniform temperature distribution over the anvil **26** assures that no or only little distortion of the anvil takes place, so that the sealing bar **29** is always parallel to the sonotrode. In the present case, the heating is carried out by two cartridges **25**. The cartridges are particularly utilized to increase the temperature of the rear jaw after a longer production-break. Additionally or alternatively, the anvil comprises a tube system **26** in the anvil **27**. Through the tube system, a liquid, preferably water, is passes to cool and/or heat the rear jaw. The tube system can be part of a closed loop comprising a heat-exchange-element to heat or cool the temperature of the liquid, if needed. As can be clearly seen, that the tube system extends along the front end **26.2** and along the rear end **26.1** of the anvil, in order to achieve a uniform temperature in the anvil. The person skilled in the art understands, that heat can be transferred from the anvil to the bearings in order to adjust, i.e. heat and/or cool, their temperature. Preferably the anvil and the bearings are at the same temperature.

[0050] Before the operation of the inventive packaging machine is started, for example at the beginning of morning shift, the rear jaw is preferably heated to its operation temperature. This is preferably done by the electrical heating elements **25**. As soon as this temperature has been reached, the packaging machine starts packaging articles.

LIST OF REFERENCE SIGNS

[0051] **1** Sealing System
[0052] **2** Front jaw
[0053] **3** Rear jaw
[0054] **4** Guide shaft, drive shaft
[0055] **5** Beam for the front jaw
[0056] **6** Beam for the rear jaw
[0057] **7** Drive shaft rear jaw
[0058] **8** Crank
[0059] **9** Rotation means
[0060] **10** Linear guide
[0061] **11** Bearing for the vertical movement of the system
[0062] **12** Bearing for the rear jaw
[0063] **13** Frame
[0064] **13.1** first segment of the frame
[0065] **13.2** second segment of the frame
[0066] **14** Side plate
[0067] **15** Bearing for the guide shaft **4**
[0068] **16** Bearing for the guide shaft **4**
[0069] **17** Motor
[0070] **18** Bearing
[0071] **19** Linear guiding means
[0072] **20** Dowel pin
[0073] **21** Fastening means, screw
[0074] **22** Bearing of the rear jaw
[0075] **23** Connection between the front jaw and the guide shaft
[0076] **24** Film sensor
[0077] **25** heating cartridge
[0078] **26** liquid circuit
[0079] **27** anvil
[0080] **28** sonotrode
[0081] **29** sealing bar

1. A packaging machine with a sealing system comprising:
a front jaw and a rear jaw, which reciprocate between an open- and a sealing-position, respectively,

whereas the front jaw comprises:

two guide shafts which are supported in a frame,

wherein the rear jaw is supported on the guide shafts of the front jaw;

a sonotrode for sealing the film material with ultrasonic sound;

wherein a motor drives the jaws and provides the pressure needed for the sealing with ultrasonic sound; and

wherein the front jaw and the rear jaw comprise heating- and cooling means.

2. The packaging machine according to claim **1**, wherein each of the two guide shafts comprises two bearings, respectively and that the two bearings are situated in a frame which is made from one single piece.

3. The packaging machine according to claim **1**, wherein a bearing of the guide shaft is located between the front jaw and the rear jaw.

4. The packaging machine according to claim **1**, wherein the front jaw is coupled to a beam and the rear jaw is connected to a beam and that each beam is supported at the frame by a linear guiding means respectively.

5. (canceled)

6. The packaging machine according to claim **1**, wherein the bearings are free from play.

7. The packaging machine according to claim **1**, wherein the front jaw and the rear jaw are driven by a servo motor.

8. The packaging machine according to claim **1**, wherein the frame is made from two pieces which are connected by two side plates.

9. The packaging machine according to claim **8**, wherein the two pieces of the frame and/or the side plates are connected by dowel pins.

10. (canceled)

11. The packaging machine according to claim **1**, wherein each of the front jaw and the rear jaw comprises two connections with shaft, respectively, whereas one connection of each jaw is an adjustable connection and one connection of each jaw is a fixed connection.

12. A sealing-jaw of a packaging machine for sealing of a film with ultrasonic sound, wherein the sealing-jaw comprises heating- and/or cooling means that maintain the sealing jaw at a uniform temperature,

wherein the heating means are electrical heating means and the cooling means is a tube system through which a liquid flows.

13. The sealing-jaw according to claim **12**, wherein the sealing-jaw comprises an anvil and that the heating- and/or cooling means are distributed at the front- and at the rear part of the anvil.

14. Method to seal a packaging with two jaws, wherein at least one jaw is tempered prior to sealing, or with a sonotrode, wherein a sealing period is adjusted based on a temperature of the sonotrode.

15. (canceled)

16. The packaging machine according to claim **2**, wherein a bearing of the guide shaft is located between the front jaw and the rear jaw.

17. The packaging machine according to claim **2**, wherein the front jaw is coupled to a beam and the rear jaw is connected to a beam and that each beam is supported at the frame by a linear guiding means respectively.

18. The packaging machine according to claim **16**, wherein the front jaw is coupled to a beam and the rear jaw is connected to a beam and that each beam is supported at the frame by a linear guiding means respectively.

19. The packaging machine according to claim **2**, wherein the front jaw is coupled to a beam and the rear jaw is connected to a beam and that each beam is supported at the frame by a linear guiding means respectively.

20. The packaging machine according to claim **18**, wherein the front jaw is coupled to a beam and the rear jaw is connected to a beam and that each beam is supported at the frame by a linear guiding means respectively.

21. The packaging machine according to claim **20**, wherein the bearings are free from play.

22. The packaging machine according to claim **21**, wherein the front jaw and the rear jaw are driven by a servo motor.

23. The packaging machine according to claim **22**, wherein the frame is made from two pieces which are connected by two side plates.

* * * * *