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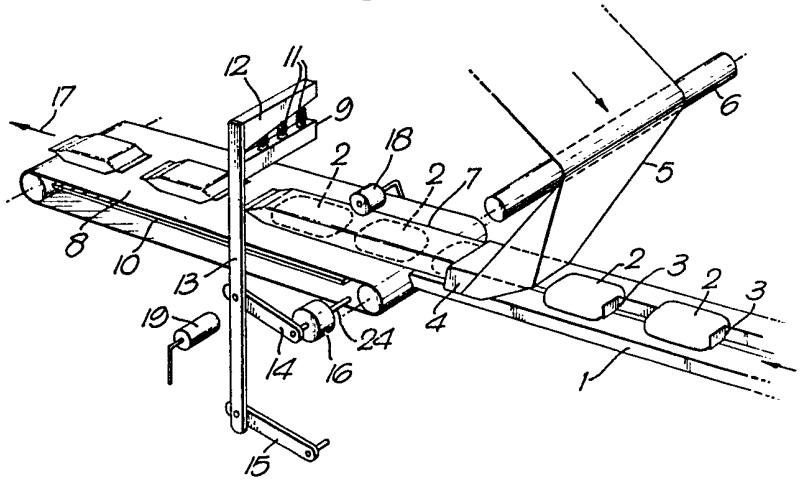
# (54) Apparatus for forming a travelling transverse seal

(57) Apparatus for forming a travelling transverse seal on a continuous flexible packaging film comprises a conveyor belt 8 over a counterpressure plate 10 capable of reciprocating to and fro in the direction of conveyor advance. A travelling seal bar 9 above the conveyor belt 10 is resiliently carried by a horizontal carrier 12 on a vertical beam 13 forming part of a driven rotating parallelogram linkage 13, 14, 15. At the bottom of the orbit of the seal bar carrier 12 the seal bar 9 is pressed into contact with flexible packaging material of a tubular structure 7 to be sealed and is then able to travel along a flat horizontal path during progressive compression and expansion of the springs 11 which mount the seal bar 9 on the carrier 12. During this flat part of the seal bar path, the contact with the flexible packaging material is long enough to effect a seal.

Fig.1.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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Fig.1.

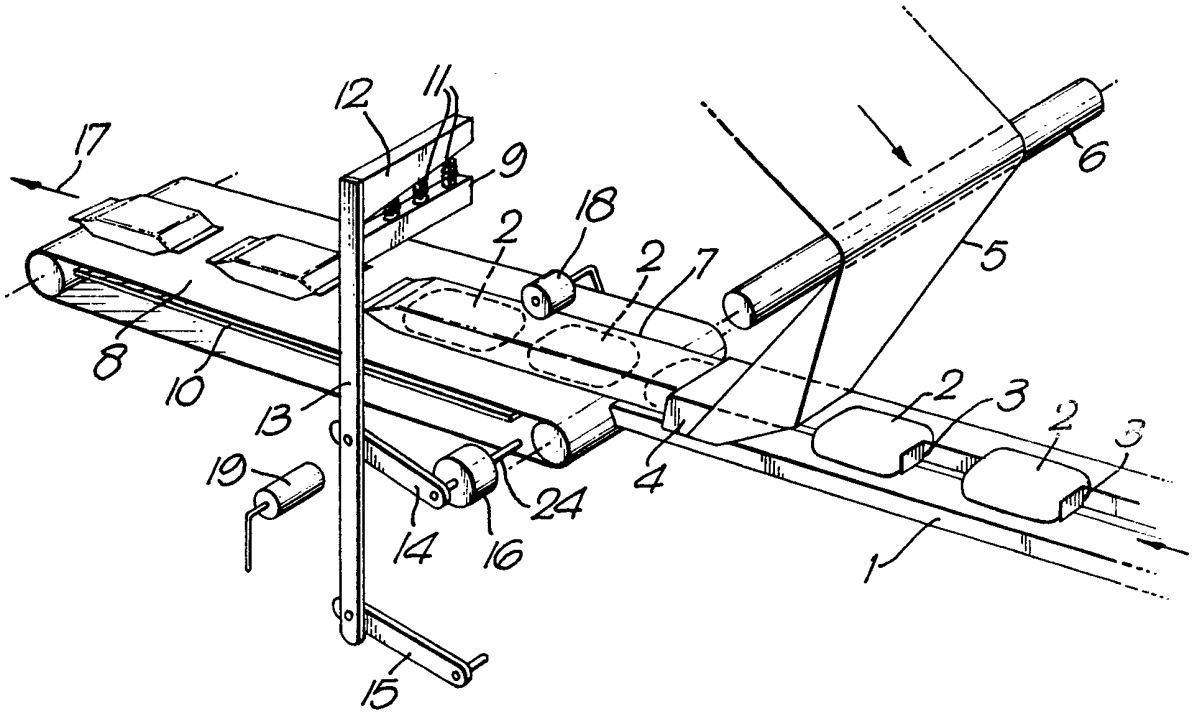
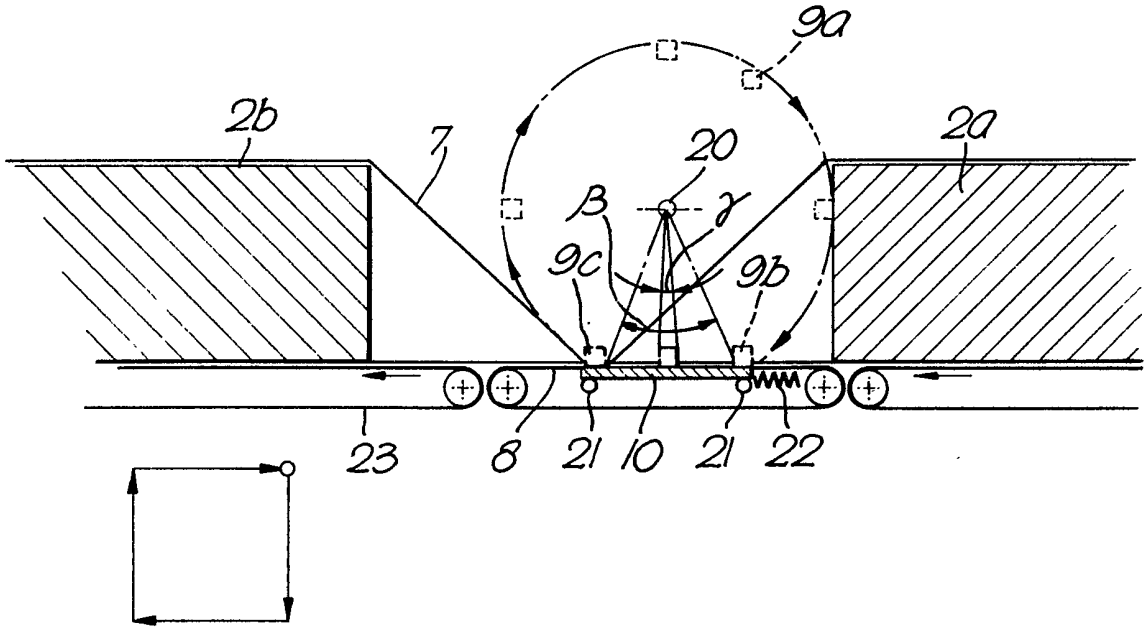



Fig.2.



SPECIFICATION

**Apparatus for Forming a Travelling Transverse Seal**

This invention relates to apparatus for forming a transverse seal on a continuous length of flexible packaging material and is particularly intended for sealing and severing a continuous tubular structure to form separate sealed packages.

Packaging apparatus known hitherto has had the facility of forming a travelling transverse seal on a tubular flexible packaging film structure but this has either required the need for two separate drive linkages, one of which effects lifting and lowering of a sealing member and the other effects advance of that sealing member while in contact with the packaging film where these two lifting and lowering actions take place simultaneously, or another known machine has a complex drive which effects motion of a seal member along a square orbit so that its travel along one side of the square leaves it between two product articles and in contact with a counterpressure surface and its travel along the next side of the square lifts it out of the path of movement of the product article while the movement along the third side brings it back to a position above its starting point, and the movement along the fourth side brings it down into contact with the said counterpressure surface. Hitherto, because of the limits of movement possible with such known apparatus it has been usual for upper and lower sealing members to be used, each then requiring only to be capable of movement in the "lifting and lowering" direction through one half of the height of the product article.

It is an object of the present invention to provide an improved apparatus for forming a travelling transverse seal, with a particularly simple drive linkage.

In accordance with one aspect of the present invention, there is provided apparatus for transversely sealing a moving packaging structure comprising flexible packaging material enveloping a series of spaced products, such apparatus comprising co-operating first and second sealing means, said first sealing means including a sealing member driven by a crank which executes orbiting movement in which a free end of the crank executes a circular motion about an axis extending perpendicular to the direction of movement of the product articles, said second sealing means including a counterpressure member movable along a direction of product advance, said first and second sealing means being positioned so that flexible packaging material can be compressed between them during forward movement of products, the flexible packaging material, and the first and second sealing means along said product advance direction; means synchronising the orbiting movement of said crank with arrival of a gap between successive said products for allowing transverse sealing of the flexible packaging material in said gap; and a connection between the crank and the first sealing member which allows limited movement of said first sealing member relative to said crank free end in a direction perpendicular to the longitudinal axis of the first sealing member whereby during the orbiting motion of the crank the first sealing member may have a rectilinear path portion to allow the first sealing member to be in maintained contact with the second sealing means during travel of the first sealing member along the direction of product movement.

Another aspect of the invention provides apparatus for transversely sealing a moving packaging structure comprising a flexible packaging material enveloping a series of spaced products, such apparatus comprising: a belt conveyor; a sealing member mounted for movement towards and away from a run of the conveyor belt and along said run synchronously with the belt while in contact with the belt to effect a travelling seal therewith; and a counterpressure member directly adjacent said run of the conveyor belt on the side of the belt opposite to that engaged by the sealing member, whereby the counterpressure member provides a reaction force to an engagement force applied by the sealing member such that the belt at said run becomes clamped between the sealing member and the counterpressure member while the flexible packaging material is being sealed by clamping between the sealing member and the belt; wherein the counterpressure member is guided for movement along a path parallel to the said run of the conveyor belt.

In order that the present invention may be readily understood, the following description is given, merely by way of example, and with reference to the accompanying drawings, in which:—

Figure 1 is a perspective view showing apparatus for sealing a continuous tube containing discrete products to form separate portions of the tube each containing a respective product; and

Figure 2 is a side elevational view showing the operation of the sealing and severing means between two adjacent product articles.

Figure 1 shows a product loading support table 1 along which a plurality of spaced product articles 2 is advanced by means of respective spaced pushers 3 which protrude upwardly above the support table. Alternatively the support table may be replaced by an endless belt conveyor without pallets.

The product articles 2 enter the folding box 4 into which a continuous web 5 of flexible packaging material is guided by way of support roll 6. In the folding box 4 the film 5 is caused to envelop the articles to form a continuous tubular structure 7 within which the spaced product articles 2 are located. Where the marginal areas of the web 5 are brought together in the underside of the tubular structure 7, they may be sealed by means (not shown).

Transverse sealing of the tubular structure 7 between successive ones of the series of product articles 2 is achieved, simultaneously with severing of the packages thus formed, while the product articles 2 in the tubular structure 7 are travelling along an endless belt sealing conveyor 8.

Figure 2 shows more clearly that the seal is formed between an upper horizontal sealing bar 9 which travels in an arcuate, in this case circular,

orbit about an axis parallel to the plane of the belt of sealing conveyor 8 but perpendicular to the direction of its advance, and a lower counterpressure plate 10 positioned immediately below the upper run of the belt of sealing conveyor 8.

Figure 1 shows that the upper sealing bar 9 is mounted on the underside of a sealing bar carrier 12 by means of support springs 11. The carrier 12 extends perpendicularly from a vertical beam 13 supported by a parallelogram linkage comprising upper and lower cranks 14 and 15, respectively, the upper crank 14 being driven by a magnetic clutch 16. Thus, during one revolution of the upper crank 14 the lower crank 15 will similarly execute a single revolution and the beam 13 will remain vertical so as to constrain the sealing bar carrier 12 for orbiting in a circular path to carry the travelling sealing bar 9 along the generally circular path shown by the dashed line in Figure 2.

As each package emerges from between the upper sealing bar 9 and the sealing conveyor 8 supported by the counterpressure plate 10, it passes onwards to be discharged along the direction of arrow 17 (Figure 1).

Figure 1 shows a photosensor 18 to detect the arrival of a product article 2 (the article 2a shown in Figure 2). Furthermore, Figure 1 shows a proximity switch 19 to detect when the crank 14 has arrived at a predetermined position at which the operation of the motor 16 stops and the sealing mechanism awaits a signal from the photosensor 18 to indicate arrival of the next product article 2*a* (Figure 2).

Operation of the mechanism illustrated in Figures 1 and 2 will now be described, with particular reference to Figure 2.

The holding position of the travelling sealing bar 9 (detected by the proximity switch 19 of Figure 1) is shown at 9*a* in Figure 2 and is above the top of the various product articles 2 passing along the sealing conveyor 8.

Only when a product article 2*a* has arrived at a position which will just allow the travelling sealing bar 9 (given the known speed of advance of product articles 2 and the known speed of orbiting of the travelling sealing bar 9) to pass downwardly in front of that arriving product article 2*a* is the magnetic clutch 16 engaged to begin rotation of the crank 14 to start lowering movement of the travelling sealing bar 9.

The magnetic clutch 16 remains engaged until the movable sealing bar 9 just touches the surface of the belt of the sealing conveyor belt 8 (at position 9*b*). Between positions 9*a* and 9*b* the travelling sealing bar 9*a* will have contacted the top of the tubular structure 7 in the gap between the two successive product articles 2*a* and 2*b* and will have pressed that top down towards the sealing conveyor 8 ready for sealing.

In order to allow prolonged sealing engagement between the upper sealing bar 9 and the flexible packaging material which separates it from the surface of the upper belt run of the sealing conveyor 8, the resilience of the springs 11 supporting the travelling sealing bar 9 from the sealing bar carrier 12 allows for horizontal leftward movement of the travelling sealing bar from position 9*b* to position 9*c* while the sealing bar carrier 12 is itself still orbiting on a vertical motion around the axis 20 (Figure 2). The orbiting movement of the sealing bar carrier 12 proceeds through a sector $\beta$ during which there is contact of the sealing bar 9 with the flexible packaging material (without slippage) and the flexible packaging material is itself held on the belt surface of the sealing conveyor 8 (without slippage). Thus there is a prolonged dwell time of $\beta/2\pi$ of a revolution of the crank 14 when there is no slippage, and heat applied to the flexible packaging material 5 by the sealing bar 9 will effect sealing and severing. Figure 2 also shows a sector $\gamma$ which is considerably smaller than sector $\beta$ and would apply if the travelling sealing bar 9 were not resiliently supported by its carrier 12 and therefore allowed to execute a flat-bottomed or "D-shaped" orbiting motion. The dwell time would, without the presence of the springs 11 then be $\gamma/\beta$ of the dwell time which can be achieved with the apparatus shown in Figures 1 and 2.

As soon as the travelling sealing bar 9 has reached position 9*c* it begins its ascent through the other part of its motion to arrive at the holding position 9*a* where the proximity switch 19 will trigger disengagement of the magnetic clutch 16.

As shown in Figure 2, the sealing counterpressure plate 10 is mounted on rollers schematically shown at 21 and is spring biased rightwardly by means of a tension spring 22. Thus, while the tubular structure of the flexible packaging material and the belt of the sealing conveyor 8 are pressed into contact with the counterpressure plate 10, the counterpressure plate 10 will travel leftwardly at the same speed of movement as the travelling sealing bar 9 and the sealing conveyor 8.

As soon as the upper travelling sealing bar 9 departs from the position 9*c* and releases the pressure of the upper belt run of the sealing conveyor 8 on the plate 10, the plate is free to return rightwardly under action of biasing spring 22 to await the next sealing cycle.

The apparatus illustrated in Figures 1 and 2 is particularly convenient for relatively tall products as it is capable of allowing clearance of the product articles 2 under the waiting upper travelling sealing bar while the latter is nevertheless able to descend to press the tubular structure between two successive product articles 2*a* and 2*b* (Figure 2) into contact with the belt of the sealing conveyor 8 and the counterpressure plate 10 when necessary.

For even taller product articles it is possible for the radius of each of the two cranks 14 and 15 to be increased (by identical amounts) so that the diameter of the orbit of the sealing bar carrier 12 can be increased. For extreme values of diameter increase it may be necessary to shift the position of the sealing bar carrier 12 upwardly along the beam 13 so as to ensure that at the lower most point of its orbit, the sealing bar carrier 12 does not actually contact the upper travelling sealing bar 9 but is still spaced from it by virtue of the resilience of the compression springs 11.

If desired, the sealing bar 9 may be constructed so that it forms a "trim seal" which does not leave the "fin" type of seal shown schematically in Figure 1.

The apparatus of the present invention is particularly convenient for use with a "form-fill seal" machine of the type shown in Figure 1 where the tubular structure 7 is formed from a flat web 5 into which the successive product articles 2 are placed. However, this particular form of transverse sealing system may be capable of use with other types of machine for forming tubular packages.

For example, it is possible for the transverse sealing bar 9 to operate for a travelling transverse seal on any continuous packaging structure, such as juxtaposed upper and lower films between which product articles are placed, and in apparatus which is capable of forming longitudinal seals along the margins of the films.

Furthermore, it is considered advantageous that the seal is made in the plane of the underside of the product article 2 so that when subsequently the sealed package is subjected to a shrink-tidy operation the transverse seal is in practice pulled onto the under side of the product article 2 upon shrinking. Thus the "fin seal" shown in Figure 1 at the front and rear end of each package will then disappear.

It is another advantage that the travelling upper seal bar 9 is carried in such a way that it maintains its orientation relative to the sealing conveyor 8 (in this case by means of the parallelogram linkage 13, 14, 15) so the sealing action exerted on the tubular structure is uniform and optimum.

Moreover, by providing a resilient connection between the travelling upper seal bar 9 exerting its D-shaped motion and the orbiting seal bar carrier 12 on a downwardly curving (e.g. circular) orbit, the drive linkage is particularly simple and is without doubt much simpler than any previous mechanism for effecting a travelling transverse seal on a continuous packaging structure.

The clutch 16, preferably a magnetic clutch, connects the drive shaft 24 to the crank 14 when the clutch is engaged, and ideally there will be some degree of slip so that once the upper travelling seal bar 9 has arrived at its position 9*b* on the sealing conveyor 8 the bar 9 is then capable of being drive along its horizontal leftward path towards position 9*c* purely by contact with the tubular structure 7 pressed against the upper run of the sealing conveyor 8. This ensures accurate synchronisation between the sealing bar 9, the sealing conveyor belt 8, and the counterpressure plate 10 during the sealing operation to avoid slippage with the film.

Although it is envisaged that the shaft 24 will be driven at a constant rotational speed on a continuous basis so that drive at a constant speed is imparted to the crank 14 only while the clutch 16 is engaged, it is instead possible for the shaft 24 to be driven by a stepper motor which allows the orbiting speed of the sealing bar carrier 12 to be varied cyclically.

For a relatively wide spacing between successive products, it is envisaged that the drive shaft 24 to the clutch 16 will rotate at a constant speed between start-up and shut-down. Where such means are provided for varying the speed rotation of the shaft 24, the travelling sealing bar 9 may execute a relatively slow movement between positions 9*b* and 9*c*, at a speed consistent with the speed of advance of the upper belt run of the sealing conveyor 8, and then execute a much more rapid movement throughout the rest of its path, but again with the holding position at 9*a* in order to allow the product article 2*a* to pass along the sealing conveyor 8 without striking the travelling upper sealing bar 9.

Clearly, the minimum length of pack corresponds to the time needed for the travelling seal bar 9 to execute its motion from position 9*c* back to position 9*b* (without a holding interval at 9*a*). This may, of course, be shortened if the variable speed drive facility mentioned above is incorporated, so that the time taken for this motion from position 9*c* to position 9*b* will be made shorter by virtue of the higher orbiting speed in this part of the path.

An important advantage of the provision of a holding portion 9*a* from which the sealing bar 9 departs only when the next product article 7 arrives, is that the product articles need not be accurately regularly spaced along the belt conveyor so it is not necessary to use palleted conveyor belts. Moreover, successive articles on the belt 8 may be of unequal lengths. Furthermore, as the belt 8, bolstered up by the counterpressure member 10, serves as one of the two sealing members the seal can be made at any location along the belt 8 and this too avoids the need for pallets having sealing means associated therewith.

Given the possibility of a palletless conveyor belt, it is then feasible to carry the flexible plastics film web on the conveyor belt by the application of suction through the belt 8 and any upstream conveyor belt which may be used for supporting the packaging structure of the flexible web 5 and spaced product articles 2.

Although, in the drawings, lost motion between the carrier 12 and the sealing bar 9 allows the sealing bar 9 to execute its D-shaped orbit, the lost motion could be elsewhere in the linkage. For example, the beams 13 may be resiliently extensible so the top ends of the beams could directly support the sealing bar 9, or the mounting for the drive shaft 24 (and the pivot bearings of the cranks 15) could be allowed resiliently resisted upward movement.

Furthermore, although the illustrated parallelogram linkage provides a convenient way of maintaining the sealing bar 9 parallel to the surface of the sealing conveyor belt 8, other linkages may be used and strict parallelism is not essential to the present invention.

CLAIMS

1. Apparatus for transversely sealing a moving packaging structure comprising flexible packaging material enveloping a series of spaced products, such apparatus comprising co-operating first and second sealing means, said first sealing means including a sealing member driven by a crank which executes orbiting movement in which a free end of the crank executes a circular motion about an axis

extending perpendicular to the direction of movement of the product articles, said second sealing means including a counterpressure member movable along a direction of product advance, said first and second sealing means being positioned so that flexible packaging material can be compressed between them during forward movement of products, the flexible packaging material, and the first and second sealing means along said product advance direction; means synchronising the orbiting movement of said crank with arrival of a gap between successive said products for allowing transverse sealing of the flexible packaging material in said gap; and a connection between the crank and the first sealing member which allows limited movement of said first sealing member relative to said crank free end in a direction perpendicular to the longitudinal axis of the first sealing member whereby during the orbiting motion of the crank the first sealing member may have a rectilinear path portion to allow the first sealing member to be in maintained contact with the second sealing means during travel of the first sealing member along the direction of product movement.

2. Apparatus according to claim 1, wherein said counterpressure member of said second sealing means is movable rectilinearly along the product advance direction and said first sealing means comprises a horizontal seal bar maintained parallel to a counterpressure surface of said counterpressure member.

3. Apparatus according to claim 2, wherein said horizontal seal bar is resiliently supported by a carrier which executes a circular orbit around an axis parallel to said counter pressure surface.

4. Apparatus according to claim 3, wherein said carrier is supported on a vertical carrier beam driven for orbiting motion while being maintained in its vertical orientation by means of a parallelogram linkage.

5. Apparatus according to claim 3 or 4, wherein said seal bar is resiliently carried by means of a plurality of compression springs extending between the seal bar and the carrier.

6. Apparatus according to any one of claims 3 to 5, wherein said counterpressure member is defined by a conveyor belt resting on a counterpressure plate, said counterpressure plate being mounted for movement to and fro along the direction of product advance.

7. Apparatus according to claim 6, wherein said counterpressure plate is resiliently biased for return movement in a direction opposite to the direction of product advance, and is driven along the direction of product advance by co-operation with said conveyor belt.

8. Apparatus according to claim 7, and including slipping drive means driving said carrier for its orbiting motion, so that once the seal bar has arrived at a position in which it presses flexible packaging material between successive said products into contact with the sealing conveyor belt, the movement of the seal bar is effected by the advancing movement of the sealing conveyor belt so as to effect gripping of the flexible packaging material between the seal bar and the conveyor belt, without slippage.

9. Apparatus according to any one of the preceding claims, and including means for arresting the orbiting movement of said first sealing means in a holding position clear of said second sealing means and clear of the product article entering the zone previously occupied by said gap.

10. Apparatus according to claim 9 and including a proximity switch effective to disengage drive to said orbiting first sealing means when said first sealing means is in said holding position.

11. Apparatus according to any one of the preceding claims, wherein said first sealing means is driven from a shaft by way of a clutch for engaging and disengaging drive, when desired.

12. Apparatus according to claim 11, when appendant to claim 10, wherein once per cycle said proximity switch disengages the clutch and then re-engages the clutch when the next seal is about to be formed.

13. Apparatus for transversely sealing a moving packaging structure comprising a flexible packaging material enveloping a series of spaced products, such apparatus comprising: a belt conveyor; a sealing member mounted for movement towards and away from a run of the conveyor belt and along said run synchronously with the belt while in contact with the belt to effect a travelling seal therewith; and a counterpressure member directly adjacent said run of the conveyor belt on the side of the belt opposite to that engaged by the sealing member, whereby the counterpressure member provides a reaction force to an engagement force applied by the sealing member such that the belt at said run becomes clamped between the sealing member and the counterpressure member while the flexible packaging material is being sealed by clamping between the sealing member and the belt; wherein the counterpressure member is guided for movement along a path parallel to the said run of the conveyor belt.

14. Apparatus according to claim 13 including means for driving said counterpressure member along its path in a direction counter to the belt movement in said run, and for allowing movement of the counterpressure member in the direction co-current with said belt movement.

15. Apparatus according to claim 14, wherein said driving means comprise biassing springs.

16. Apparatus for effecting a travelling transverse seal on a moving package structure, substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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